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THE OLD AND THE NEW IN PROSTATIC SURGERY

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I recently went into the operating room while a friend was being relieved of a condition caused by an enlarged, obstructing prostate gland. Although it is only a few years since the present methods of removing prostatic tissue transurethrally have become widely used, the refinements in instruments, and the development of technic in this work have been remarkable. The ease of the operation, with the patient under spinal, local, or gas anæsthesia, and the short time required to accomplish the work, recalled to my mind the prevailing views concerning physiology, pathology, and surgery of the prostate gland that have been current at various times in the last forty odd years, and the many changes that have gradually occurred in our ideas and methods of treatment.

I remember forty years ago, at a medical meeting, my brother, W. J. Mayo, said that prostatic enlargement was seldom found in the pure-blooded negro and that it seems possible that the necessity, sometimes imposed by our civilization, of holding an uncomfortably large amount of urine in the bladder, might influence the gradual growth of adenomatous tissue within the prostate gland which would more firmly close the outlet. The busy man of our times, who attends board meetings, conferences, committee meetings, and so forth, often finds it necessary to delay relief of vesical pressure, and finally, perhaps, the outlet of the bladder prepares to care for itself. Those who are engaged in research on dogs find that they can tell the house-broken dog from the dog raised on the farm because the former has an enlarged prostate gland, but the latter has not. Although these observations may appear primitive and unscientific, they may be significant, notwithstanding that at present we hear more of the influence of the secretions of various endocrine glands on the growth of the prostate gland. We still have a great deal more to learn regarding the true cause of adenomatous hypertrophy of the prostate gland, as well as of hypertrophy of the thyroid gland, and of other glandular structures.

In my father's day real urinary obstruction from prostatic enlargement was not uncommonly caused by sudden swelling of the prostate from sitting on a cold stone. This was often sufficient to produce obstructive congestion in men of sixty or seventy years of age, and if the bladder was emptied by catheter a few times, even if the obstruction was not relieved, the attack usually passed off. A few ounces of urine was not considered an unusual

amount to be retained in the bladder. My father showed me how, if a larger bend were made in the stylet catheter, it could be passed through the urethra with but little trouble, and this became a very useful procedure in the presence of obstructing prostate glands. Forty years ago, all who drained an over-distended bladder were trained to reduce the tension slowly, by connecting the catheter to an elevated bottle, so that the bladder was emptied under pressure, and some hours were taken to accomplish the process, possibly thus avoiding urinary suppression. It is of interest to note the remarkable change in attitude that the patients suffering from prostatic obstruction have toward its treatment today. It is unusual to observe large amounts of residual urine nowadays. The early removal of the obstructing prostatic tissue will undoubtedly radically alter the clinical conditions formerly observed with prostatic obstruction of long standing.

The ureters of men sixty or seventy years of age are quite open as they pass into the bladder, whereas those of young persons pass obliquely through the walls of the bladder and remain closed. This has to do with pyelitis and kindred ills from ascending infection. For instance, we seldom think of the kidney being lower than the bony pelvis because we think of the man as upright; however, when he is lying in bed, the kidney is lower than the bladder and, when the bladder is infected and the ureters are open, pyelitis very commonly occurs. The intermittent pressure of the circulation within the glomerulus, and the consequently varying flow of urine down the tubules and into the renal pelvis, balanced against the intermittent pressure within the bladder, may lead to infection of the renal tissue and to multiple abscesses in the renal parenchyma in some cases.

Long ago I learned from my father to put old people to bed only for as short a time as was absolutely necessary, for they were like a foundered horse, if they got down it was difficult for them to get up, and their strength ebbed away very rapidly while in bed. Another thing which my father taught me was never to pay much attention to heart disease, even though it might be quite evident in all examinations, unless the patient came to me with the heart as the prime factor in his disease. If he came for other troubles, father said to pay little attention to valvular murmurs, and old heart troubles, as long as the heart was accomplishing its work without œdema. If operation was necessary for the good of the patient, it should be done for what he desired to be relieved of, and he should not be treated for something else, even if he had it, at least until he had been relieved of his disabling trouble.

I noted in the pre-operative work in the hospital that many were undergoing drainage of the bladder and irrigations in an attempt to clear up infections. These old people were down for a considerable period, often for several weeks, and sometimes they could not get into satisfactory condition for operation on their prostate gland, especially by suprapubic drainage which required on the average forty-two days in the hospital, including the subsequent prostatectomy.

Before the development of perineal prostatectomy, operation on the prostate gland was usually employed only as an emergency procedure to relieve acute obstruction following injury in this region; consequently, many of the patients treated in this manner were in extremely poor condition and, as a result, the mortality rate was high. As we began to realize that repeated and prolonged catheterization led inevitably to infection of the urinary tract, and as this type of surgery was more fully developed, operation was performed earlier, while the patient was in better condition. It is of interest to note that catheterization is now employed preliminary to transurethral surgery. Resection is usually done after only one or two days of drainage by catheter, provided the renal function permits.

Surgeons began, in the early 1890's, to operate on the prostate gland for relief of chronic obstruction. When I first started removing enlarged prostates a controversy was current that was very similar to that which is being carried on at present. Some favored the endoscopic procedures devised by Bottini and Mercier; others were in favor of open operation by the perineal or suprapubic approach. Adherents of endoscopic procedures were handicapped by lack of complete visibility, and inadequate methods for control of bleeding. Although many patients were successfully relieved of their distressing symptoms by this type of treatment, gradually the incomplete visibility and the inadequate hæmostasis caused a general trend toward open operative procedures. I was stimulated by Doctor Goodfellow, of San Francisco, and I had time to discuss with him this particular branch of surgery at the meetings of the Western Surgical and Gynecological Association in the 1890's.

In some cases in which the glands were particularly large, my brother performed the suprapubic operation, and I performed the perineal operation. I operated on more than 700 patients by this method, with a mortality rate varying from 5 to 7 per cent. Pre-operative preparation was employed in very few cases. Through a transverse or inverted "Y" or angular incision, the prostate gland was exposed, the capsule incised, and the adenomatous prostate was enucleated from its surrounding fibrous capsule which formed a shell and was really the true prostate. The low mortality rate in those days was explained by the fact, I think, that perineal prostatectomy gave immediate drainage, the operation was conducted in a simple fashion, and the patients were urged to be up soon as possible. The undesirable results were largely due to faulty pre-operative appreciation of the exact extent and nature of the disease. Sometimes prostate glands of excessive size were removed perineally, and coexisting vesical calculi or vesical neoplasms were not recognized. As a rule, however, by digital examination through the rectum the size of the gland, and the depth of the perineum could be readily appreciated. We gradually learned that if the perineum was unusually deep, and the gland very large, suprapubic removal was more satisfactory, particularly if additional pathologic change existed in the bladder. Gradually the suprapubic operation became more popular, and prolonged, preliminary preparation for operation came into vogue. However, the operative results were

not greatly improved, although larger tumors were more readily removed in this manner, and complications were more readily met.

Recently, the surgical management of prostatic hypertrophy has distinctly changed. The present-day instruments for transurethral removal of the prostate gland, which have been designed so as to preserve the fundamental principle of the procedures of Bottini or Mercier, have been greatly improved. Adequate vision of the operative field, and efficient methods for obtaining complete hæmostasis, have added greatly to the popularity which this type of operation has gained. In part this has been but another example of the development of electrical, mechanical, and physical devices which have made such forward strides in the last few decades. The development of transurethral prostatic resection was greatly furthered by the observations of Caulk, who found that removal of the obstructing prostatic tissue at the vesical neck was followed by marked shrinkage in the remaining prostatic tissue. Another development of importance was the employment of surgical asepsis in post-operative management and drainage. Secondary infection, and not the primary organism, was frequently the cause of post-operative infection that formerly was observed. This has been obviated largely by the present-day technic. In the past, a patient who underwent suprapubic prostatectomy would spend approximately six weeks in the hospital; one who underwent the perineal operation would be in the hospital two or three weeks, and at present the patient who undergoes transurethral prostatic resection usually remains in the hospital five or six days. The mortality rate of this last method was somewhat less than 1 per cent. in the last 900 cases in which it was used at the clinic; at this writing there have been no deaths in the last 361 consecutive cases.

Chronic prostatitis, as a cause of considerable enlargement of the gland, was not appreciated in the early days of prostatic surgery, and operation was sometimes performed for this type of chronic inflammation. This condition now is recognized, and is wonderfully relieved by local treatment and massage which, in many cases, will cause the infection and the enlargement almost to disappear. In some cases of chronic prostatitis which cause but a small amount of residual urine, transurethral removal of the prostatic tissue obstructing the neck of the bladder has relieved the patient's symptoms and markedly improved the inflammatory condition in the prostate. In some instances excision, with thorough drainage of the closed prostatic ducts, has improved the condition materially.

I fortunately entered surgical work when methods of antisepsis were being employed and before asepsis was generally in use. I have witnessed the whole period of change from the old to the new, and when I witnessed the simplicity, and the ease of transurethral prostatic resection I could not help but review in my mind the changes that have taken place in prostatic surgery. I have set down the changes in this field as being typical of present-day surgical methods, so many of which are life-saving and safe, and accomplish all that is desired quickly and easily.

URETERO-ARACHNOID (URETERODURAL) ANASTOMOSIS

WITH REPORT OF THREE CASES

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Internal hydrocephalus as a disease presenting a mechanical obstruction to the free flow of a fluid has been a challenge to the utmost ingenuity of surgeons, an ingenuity that in many instances has far over-reached itself. For the obstructive variety, that is, the type in which the ventricular system is blocked off from the cisternal and subarachnoid areas, the various procedures for tumor and Dandy's[1, 2] drainage of the ventricles through the floor of the third ventricle are logical. Dandy's operation is applicable, of course, only when a normal cisternal and subarachnoid system exists, a situation he tests by observing the rate of excretion of phenolsulphonphthalein in the urine after injection into the spinal canal.

The treatment of the communicating variety of the disease is a somewhat different problem. Here the cerebrospinal fluid finds its way through the foramina of Luschka and Magendie, only to be blocked along the cisternal pathways beneath the cerebrum or in the subarachnoid spaces above. It is common knowledge that no surgical method of treating this condition has met with any consistent success. When one considers the unhappy state of patients suffering from either type of hydrocephalus, when the condition is progressive, the need of an adequate surgical procedure for the communicating type needs no argument. The present paper is the record of experience with one of the surgical methods proposed.

The various surgical operations devised for the treatment of communicating hydrocephalus were completely reviewed by Davidoff,[3] in 1929. There is no need to repeat such a review in detail inasmuch as no procedure has been satisfactory in any important number of cases, as judged not only by the reports but also by the failure of any procedure to become standard practice. Many of the methods are theoretically applicable to both the ventricular or non-communicating type and the extraventricular or communicating type. Two general surgical methods have been employed. The first is based on an attempt to diminish cerebrospinal-fluid production by removal of the choroid plexus or by ligation of the carotid arteries.[2] The second is an attempt to sidetrack the fluid around the obstruction into an area where absorption may occur. The Anton-Bramann corpus callosum puncture and Dandy's operation on the floor of the third ventricle are examples of these methods as applied to the non-communicating type. Attempts to drain the lateral ventricles into the veins and the subcutaneous tissue may be applied to either type. Similar attempts to drain the fluid from the spinal subarachnoid space

into the veins, the subcutaneous tissue, the pleura or the peritoneum are limited to the treatment of communicating hydrocephalus.

In all methods directed towards continuous drainage of cerebrospinal fluid, whether from the ventricle or the spinal subarachnoid space, the technical problem of the construction of a permanent channel has been the first and most important difficulty. Every conceivable type of material has been used. An incomplete list includes silk, linen and catgut setons, glass wool, tubes of gold, silver, glass, rubber and hardened calf's arteries, segments of the patient's veins and arteries, strips of dura, of fat and of omentum, and even the serous coat of a loop of intestine brought into a laminectomy wound. The difficulty in judging the results is increased by the well-known fact that spontaneous compensation in communicating internal hydrocephalus often occurs, the so-called "arrest" of the disease. In most instances in which pathological study has been done, these artificially constructed channels have been shown to have healed over at one or both ends, or throughout their extent. The mere arrest of the disease and survival of the patient are no measure of the efficiency of the drainage system.

In 1925, Heile[4] of Wiesbaden, after earlier attempts using some of the methods mentioned above,[5, 6, 7] proposed a new operation which apparently has not had a wide trial in this country. It consists in the extirpation of a kidney and the anastomosis of its pelvis to an opening in the lumbar dura. Heile has published at least twice[8, 9] since his original communication, reporting clinical cases and experimental anastomoses in dogs, and modifying his technic in some details. The completely developed technic is summarized in his latest available paper and may be quoted in free translation as follows[9]:

"(*a*) Exposure of right or left kidney. Extirpation of the kidney. Ribboning of the distal end of the kidney pelvis for a length of about two centimetres, avoiding carrying the ribbons into the ureter proper so as not to lose too much length." (The illustrations show three ribbons.)

"(*b*) Laminectomy at the level of the lumbar vertebræ, carried as far as exposure of the dura without opening it. Accurate careful hemostasis.

"(*c*) Blunt undermining of the long muscles of the back with a clamp from within the abdominal wound pushing through into the laminectomy wound. The freed ureter must then be able to be sutured to the dura without tension; otherwise the canal through the muscles is not sufficiently caudad.

"(*d*) Passage of a ureteral sound through a small incision in the ureter a hand's breadth above the bladder. The sound is pushed upward until it appears within the kidney pelvis. The lower end of the sound remains in the temporarily packed abdominal wound. The open end of the ureter armed with the sound and with guide sutures is then carefully passed through the canal in the muscles into the laminectomy wound.

"(*e*) Opening of the dura. Careful, gradual introduction of the ureteral sound through the slit in the dura into the dural space. (Duraraum.) While the free ribbons of the wall of the pelvis are held aside, the exposed epithelium of the inner opening of the ureter is sutured with interrupted silk sutures into the dural slit. Then the free ribbons, from which the epithelium has been removed, are sutured laterally against the neighboring surface of the dura with interrupted silk, the ureteral sound being still in place.

"(*f*) Careful closure of the laminectomy wound in layers. The ureteral sound is

then carefully and slowly withdrawn from the small lateral wound in the ureter, which is closed by a single suture. Closure of the laparotomy wound."

Parenthetically, it may be remarked that the elaborate technic including ribboning of the kidney pelvis and the use of the ureteral sound is not at all necessary if another obvious modification of the operation, to be described later, is employed. As a matter of fact, Heile adopted these two features after his original publication. In passing I should like to call attention to the fact that he speaks always of a "slit" (Schlitz) in the dura and of the "dural space." (Duraraum.) The significance of this comment will appear later.

If one admits the desirability of continuous drainage of cerebrospinal fluid, this operation has certain theoretical advantages over others. Only one anastomosis must remain permanently patent; the passageway employed consists of the patient's own tissue, retaining its circulation and perhaps its peristalsis; and there is no problem presented of absorption of the fluid.

Nevertheless, the operation has been but rarely employed, particularly in this country. Christopher,[10] in 1929, reported two cases, using the dural sac of a spina bifida and passing the ureter subcutaneously. One child died on the table. The other was subjected to a revision of the anastomosis three weeks after the first operation. The child showed temporary improvement. Davidoff and Bancroft,[11] in 1932, reported a single case, using Heile's technic almost completely. This child lived a week. Patency of the lumen of the anastomosis was demonstrated radiologically at post-mortem by the injection of sodium iodide into the ureter. These are the only reports that I have been able to find in the American literature, although unquestionably sporadic trials of the procedure have been made. I know of at least two such on the part of Dowman and Fincher,[12] of Atlanta. In Germany and Russia a few cases have been reported. Drachter,[13] a few weeks after Heile's first report on the method, reported a case done by him eight years earlier. The child died on the second day. Heile,[9] in 1928, had operated on three cases. One died at operation from accidental injury to the pleura during nephrectomy. One was practically symptom-free at the end of three years and one showed improvement at the end of five months. He also mentions two other cases, one by Kreuter that died a few days after operation and one by Korr, alive and successful at three weeks. Kartava,[14] of Odessa, in 1933 summarized the Russian literature, collecting twelve cases and adding one of his own. In these cases various unimportant modifications of technic were employed. Voznesenski, Zdanaobski and Kartava are each credited with one case, and Polenov, Maximovitch, Kasanski, Burdenko and Michelson with two. Among these thirteen cases there was one operative death. The anastomosis in Michelson's two cases never functioned. In the others function is said to have been established. Kartava's case died on the eighteenth day in convulsions. Although the cases are not tabulated, apparently four of them were so successful as to be demonstrated before the Pirogov Surgical Society of Leningrad. One other (Kasanski) was progressively improving

at three months. Kartava is an ardent propagandist for Heile's operation; but his paper should be read by all interested in the subject.

In the cases thus briefly summarized, the operative mortality has been high, approximately 20 per cent. if one includes all deaths within a day or so of the operation. This is higher, I believe, than the nature of the operation justifies. The later mortality at from two to four weeks adds greatly to the total hospital mortality, a point to be discussed below.

The present paper will present three additional cases, in one of which the probability of a permanently patent anastomosis when properly done is strongly suggested. Important modifications of the operative technic will be described. And lastly, some sort of estimate of the place of this operation will be attempted.

Before presenting the cases in which Heile's operation has been done, it will be well to describe the operative technic as I have carried it out.

The patient is first studied with dye or air injections or both to determine as closely as possible the position of the obstruction and to make certain that a communicating internal hydrocephalus exists.

The patient is then studied from the point of view of the kidney. In our three cases, intravenous urography was employed in order to demonstrate that two kidneys are present and are in normal position. The urine is, of course, examined for evidence of infection of the urinary tract. In the single adult case, a differential kidney function test was also carried out in order to spare the kidney with the better function. The right kidney was chosen in the first case as a result of this test. In the other cases, the right kidney was also employed simply because we were familiar with operating from that direction. Heile and other authors advise the left kidney because, being somewhat higher, it offers a somewhat greater length of ureter. In our experience the length of the right ureter is adequate for anastomosis without tension. In each instance, Dr. J. H. Neff, in charge of the department of urology, has performed the nephrectomy.

Parenthetically, it may be noted that the preliminary study of the urinary tract in one unoperated case led to an important observation in regard to the place of this operation in hydrocephalus. Several operations have been done in the presence of spina bifida. (For example, Christopher.[10]) A four-months-old child with hydrocephalus beginning after the spontaneous closure of a cerebrospinal-fluid leak from a large meningocele was studied with the idea of combining cure of the meningocele with permanent cerebrospinal-fluid fistula. The child had a good rectal sphincter and muscular activity of the legs and it was therefore considered operable from the point of view of the meningocele. The uroselectan studies showed the right kidney pelvis well outlined, somewhat low and connected with a tortuous and slightly large ureter. No definite shadow could be seen on the left side although intestinal gas and the shadow of the meningocele obscured the reading of the film. Cystoscopy was therefore performed with the finding of a typical "cord bladder." The left ureteral orifice was patulous and a pyelogram

showed a hydronephrotic kidney on the left with a markedly dilated, tortuous ureter. It was, of course, obvious at once that Heile's operation was not suited for this case inasmuch as urinary back pressure would force urine into the subarachnoid space. This observation needs particular emphasis because of the fact that it apparently has occurred to no observers that disturbance in bladder function associated with spina bifida might be a contra-indication to the procedure. The prime necessity for thorough pre-operative investigation of the entire urinary tract becomes obvious.

FIG. 1.— (Case I.) Photograph taken about two weeks after uretero-arachnoid anastomosis. The limits of the laminectomy incision are marked by dots.

Pre-operative preparation of the patient has had no other special characteristics. We have not attempted to lower the intracranial pressure by repeated taps as suggested by some authors. The steps of the operation itself are as follows:

(1) The position of the patient on the table is about halfway between the prone and the lateral position. During the manipulations necessary in performing the laminectomy and making the anastomosis the patient can be rotated a few degrees farther towards the prone position. During the nephrectomy the patient can be rotated into the lateral position without disturbing the drapes. The relative position of the two incisions may be seen in Fig. 1.

(2) Under local infiltration anæsthesia, a laminectomy is done involving the second, third and fourth lumbar vertebræ. The dura is exposed and careful hæmostasis is accomplished. In the first operation we exposed the dura over the entire extent of the wound. In later operations a limited extent of the dura was exposed by the removal of from one to one and one-half laminæ, giving just sufficient area for the anastomosis. It is necessary, I think, to remove at least three spinous processes in order to make the wound large enough for easy suture. The laminectomy wound is packed with moist cotton.

(3) Right nephrectomy is then done, under general anæsthesia. In the infants this is a very light primary ether anæsthesia given by the open drop method. Doctor Neff first severs the vascular pedicle of the kidney

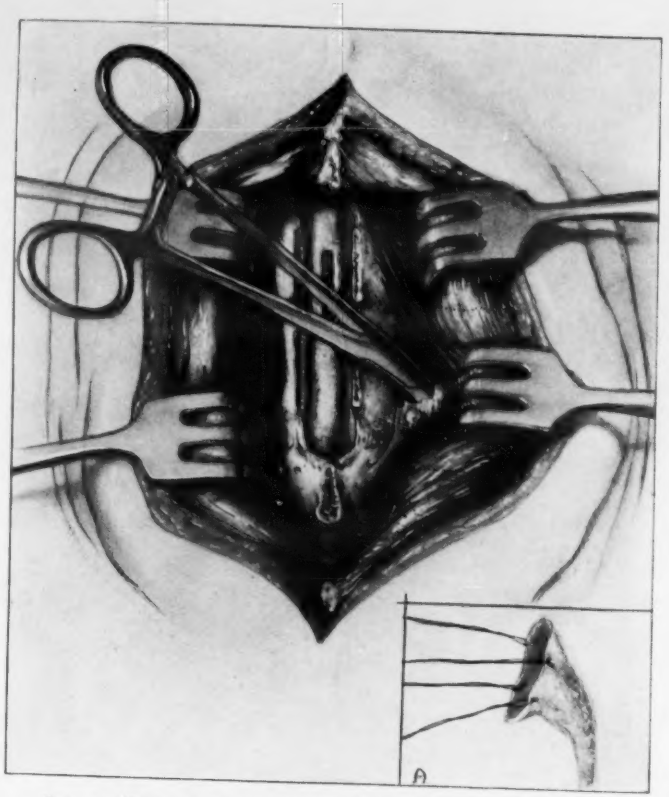

FIG. 2.—Removal of the spines of three vertebræ and laminectomy of two vertebræ have been completed. The clamp is being thrust between the third and fourth transverse processes into the retroperitoneal space. The position of the dural window is indicated. Ordinarily this window is not made until the kidney pelvis is in the laminectomy wound and the position of the opening can be chosen on the basis of available tissue. The insert shows the kidney pelvis prepared with guide sutures for pulling through the muscle tunnel.

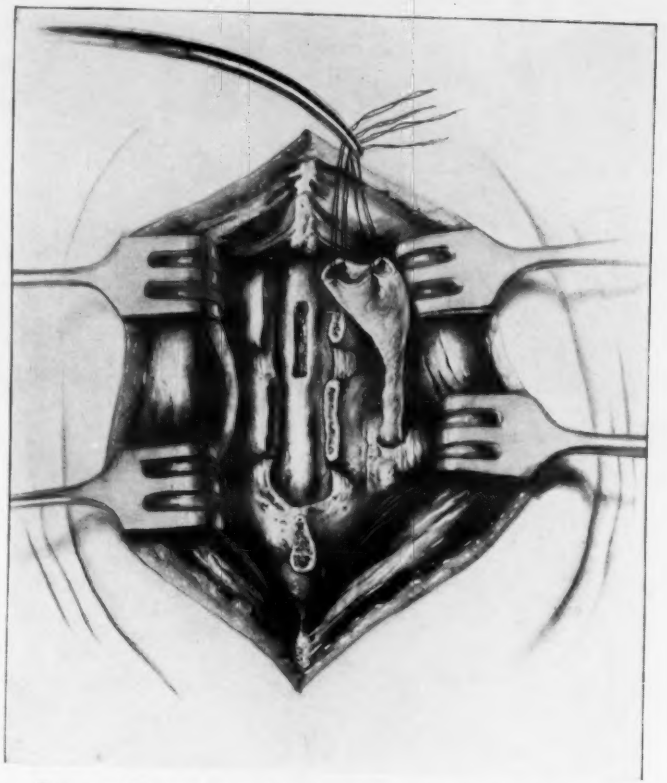

FIG. 3.—The next step following Fig. 2. The kidney pelvis has been drawn through the muscle tunnel and the window in the dura has been made.

and brings the organ out of the wound attached to the ureter. He then dissects back into the kidney substance to the point of division of the pelvis into the calyces, at which point amputation of the kidney pelvis is carried out. In one instance he divided above this point across the major calyces themselves, so that there were two distal openings of the kidney pelvis. These were easily made into one large orifice by dividing the bridge between them. In one instance the pelvis was bifid and it was necessary to ligate one arm and use a rather smaller distal opening. As soon as the pelvis is freed, four guide sutures of fine silk are passed through its borders. (Fig. 2-A.)

The ureter is dissected free well down towards the bladder. The extent of this dissection will depend somewhat on the length of ureter demanded in the particular case. Two or three centimetres in length can be gained by further freeing if necessary later in the operation.

(4) The pack is then removed from the laminectomy wound and the accuracy of hæmostasis is reviewed. A round-nosed hæmostat is thrust between the transverse processes of the third and fourth lumbar vertebræ being guided by a hand within the abdominal wound. (Fig. 2.) It is directed obliquely downward towards the bladder and penetrates into the retroperitoneal space just lateral to the psoas muscle. The tunnel so created is slightly enlarged by divulsion. The clamp at once seizes the guide sutures and gently draws the kidney pelvis and ureter into the laminectomy wound. (Fig. 3.) Approximation of the kidney pelvis to the dura is tested. If the two structures do not lie in proper apposition without any tension, the ureter is somewhat further freed towards the bladder. In none of the three instances was there any tension after this manœuvre. The kidney wound is then closed in the usual way.

(5) At this point a radical departure from the originally described technic has been made, namely, the formation of a window in the dura rather than a slit. This seems to me an important modification on account of the fact that the cut edges of the dura are thereby so far separated that immediate union by granulation tissue is obviated. The size of the window may vary. If the window is large as compared with the opening of the kidney pelvis, the latter will act as a diaphragm with the ureteral orifice at its centre. (Fig. 4C.) If the window is small as compared with the opening of the kidney pelvis, the latter will act as a wide-mouthed funnel. (Fig. 4B.) Further experience should give some information as to which is the better method. The window in the dura is made with the hook and fine knife in the usual way, and the excised piece of dura is discarded. At this stage the patient's head is somewhat lowered to prevent too rapid escape of cerebrospinal fluid. A corresponding opening in the arachnoid, which need not be a window, is made.

(6) Very fine waxed silk in fine curved French needles is used for the anastomosis. On the side away from the operator, interrupted sutures are placed at short intervals and tied within the lumen of the anastomosis. Fig. 4A.) These sutures pick up, first, the entire thickness of the edge of the

kidney pelvis from within outwards; second, the entire thickness of the dura; and third, a good bite of the arachnoid membrane. This, of course, unites the arachnoid to the epithelium of the kidney pelvis and directly drains the subarachnoid space. The failure to mention specifically the subarachnoid space in all previous descriptions of the operation is striking. On the side near the operator the sutures are placed in the opposite direction and tied on the outside. This method of placing sutures has been chosen only as a matter of convenience, as the anastomosis has been so easily performed in this manner. The portion of silk, including the knots on the distant side, which are exposed within the joined cavities of the kidney pelvis and subarachnoid space, are apparently well cared for in the healing process, as will be shown in the material that is to be presented below.

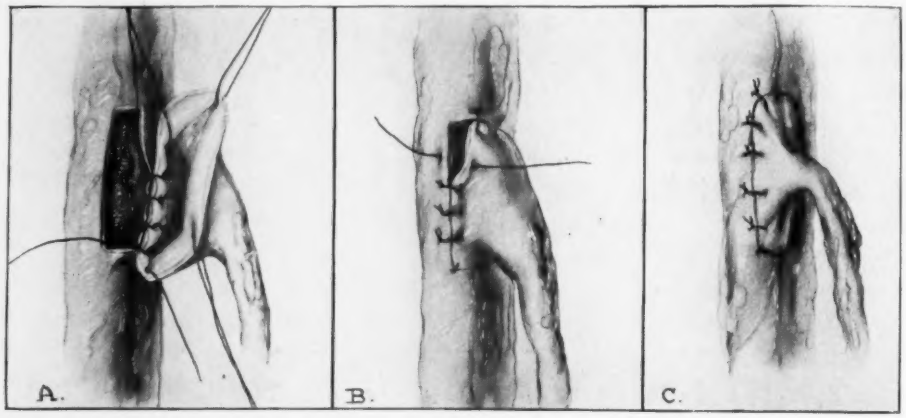

FIG. 4.—(Case I.) Detail of suture. (A) The sutures are placed on the side away from the operator and tied within the lumen of the anastomosis. The drawing does not show the inclusion of the arachnoid in the bite of the stitch. For clarity the knots are shown with ends much too long. (B) The sutures are placed on the side near the operator. Again the arachnoid is not shown. This drawing illustrates the final result when the opening in the dura is small as compared to the orifice of the kidney pelvis. The latter acts as a funnel. (C) The sutures completed. This figure shows the effect of an opening in the dura large as compared to the orifice of the kidney pelvis. The latter acts as a diaphragm with the ureteral opening at its centre.

(7) After again a complete toilet of the wound, the laminectomy incision is closed in layers with fine silk. A silver-foil dressing is applied.

CASE I.—(University of Virginia Hospital No. 104278). A single white farmer, aged twenty-four years, entered the hospital on the neurological service of Dr. D. C. Wilson, July 3, 1933, with a brief history suggesting a tumor of the left parietal cortex. About three weeks before entrance he was suddenly seized with severe headache and vomiting. This was shortly followed by some slowing of his mental reaction. About one week before entrance he had a sudden pain in the left side of his head which radiated to the right arm followed shortly by loss of feeling and paralysis of the right arm. A few hours before admission he had a sudden development of aphasia. During the three weeks' illness he lost about twenty pounds. Previous to the onset of his illness he had occasionally complained of headache and dizziness.

On admission to the hospital he was stuporous. Temperature was 99.4°, and the systolic blood-pressure 108. The pulse rate varied from 48 to 54. There was a bilateral papilloedema, measured at one and a half diopters in the right eye and two and a half diopters in the left eye. There was a flaccid paralysis of the right arm and weakness

and clumsiness of the right leg. The patient recovered somewhat from his stupor so that other examination was possible. It became obvious that there was an aphasia which was probably of the motor type. The right abdominal reflexes were absent. All other neurological reactions were normal, including vestibular tests. The visual fields could not be mapped.

Operation was done on the second day after admission without further study on account of the clear-cut picture of a left frontoparietal lesion with markedly increased intracranial pressure. A bone flap was turned down in the usual way. The dura was extremely tight and a ventricle tap was done, obtaining about thirty cubic centimetres of fluid. The exploration was otherwise negative except for flattening of the convolutions and some generalized increase in cortical vascularity. The wound was closed, leaving a subtemporal decompression opening. The post-operative course was entirely smooth with considerable bulging of the decompression but without relief of focal symptoms. There was no improvement in the swelling of the discs. Three weeks after operation when the patient had been returned to the neurological service, an encephalogram was done. One hundred forty cubic centimetres of fluid were obtained. The X-ray film showed a communicating internal hydrocephalus, dilatation of the third ventricle and no air over the cortex.

The patient was discharged a few days later and was readmitted after ten days without improvement. The decompression was bulging. There was still choking of the discs. He was admitted on the neurological service for the purpose of continuous spinal drainage by needle puncture. This gave him some slight relief. However, when the pressure was not kept down almost constantly, his pressure signs recurred. The encephalogram was repeated September 12, 1933, and showed the same findings as before, except that there was an enormous increase in the degree of internal hydrocephalus, especially on the left side, where a large localized dilatation had taken place. This, however, did not correspond with the position of the decompression opening.

At this time it was felt that the patient probably had had an arachnoiditis as his original disease. At the time of his first operation an internal hydrocephalus was just beginning. Its progress is shown graphically by the change in size of the ventricles. No explanation for the focal symptoms was apparent. There seemed to be no hope for the patient unless something was done for the communicating internal hydrocephalus and it was therefore decided to attempt to drain the cerebrospinal fluid into the bladder.

A uroselectan examination was made showing normal position and outline of the kidney pelves with normal time of appearance of the shadow. A differential kidney functional test was done by Dr. J. H. Neff which showed slightly better kidney function on the left, although the function of each side was approximately normal. There were no pathological elements in the urine from either kidney.

September 21, 1933, a ureterodural anastomosis was performed after the technic described. It is to be noted that at this first experience with Heile's operation the importance of including the arachnoid in the suture was not recognized and no particular attempt was made to employ it.

The patient went through the operation in excellent condition. His highest post-operative temperature was 101.4°, rectal. A normal temperature was reached and maintained on the tenth day. For the first week after operation there was no apparent change in his condition but shortly thereafter he began to improve materially and the decompression which had been bulging became depressed. (Fig. 5.) October 10, 1933, nineteen days after operation, a cystoscopical examination showed profuse flow of indigo carmine from the right ureteral orifice after the injection of the dye into the subarachnoid space. Thus the patency of the anastomosis at that period was demonstrated. The operative scars are shown in Fig. 1. The patient was discharged a week later. His improvement at this time was marked. His speech defect was apparently improving; his strength and weight were better each day; and incontinence, which had been persistent for weeks, had disappeared. His mental state also was considerably improved.

He was readmitted November 13, 1933, seven and a half weeks after operation, on account of slight bulging of the decompression and recurrence of urinary and fæcal incontinence. There were no new findings. There was no choking of the discs. Two attempts were made to demonstrate the passage of dye into the bladder, both of them negative. However, at one examination, the observer was quite certain that a spurt of clear fluid was expelled from the right ureteral orifice.

The patient was re-examined January 12, 1934, and March 30, 1934, and no fluid or dye could be seen appearing at the right orifice. During the period since operation he has been in fair condition. He has had no headache, his appetite is good and his weight has stayed up. He has occasional difficulty in controlling his urine. His right side is still somewhat weak although it is apparently improving and there is still a marked motor aphasia. No choking of the discs is present. The decompression varies in tenseness. March 30, 1934, it was depressed beneath the normal skin level. A short time previously the patient had been able to walk two miles. A photograph taken five months after operation shows the patient's excellent state of nourishment.

FIG. 5.—(Case I.) Photograph taken about two weeks after uretero-arachnoid anastomosis, showing depression of previously bulging decompression opening.

FIG. 6.—(Case II.) Photograph one week after uretero-arachnoid anastomosis showing depressed anterior fontanel.

The explanation for the patient's continued good condition after apparent closure of the drainage opening can be only that some degree of compensation for the internal hydrocephalus has occurred. The failure of the anastomosis to remain open is interesting. In view of later observations there is a possibility that it may have closed because of failure to unite the arachnoid membrane to the kidney epithelium.

CASE II.—(University of Virginia Hospital No. 98185.) An illegitimate male baby born in this hospital July 8, 1932, was readmitted to the neurological service October 8, 1933, at the age of fifteen months. At birth a supernumerary thumb and a defect in the occipital bones were noted. A hydrocephalus was first observed in the dispensary September 5, 1932. At this time bilateral optic atrophy was reported.

On admission in October, 1933, the child had the typical appearance of hydrocephalus of a marked grade. There was marked spasticity of all the extremities, hyperactivity of the deep reflexes and poorly sustained ankle clonus. The anterior fontanel measured 7.5 by 8 centimetres. The circumference of the head was fifty-six centimetres in the occipito-frontal plane. The occipito-frontal diameter was twenty centimetres, and the biparietal diameter 18.5 centimetres. The child was apparently blind and the eye-grounds showed scarring and pigmentation with marked atrophy of the discs. During observation the child had several generalized convulsions.

On account of the interest stimulated by the first case of drainage of cerebrospinal

fluid into the bladder, this child was referred by Dr. D. C. Wilson with the idea that uretero-arachnoid anastomosis was indicated. There was no real hope of improving the prognosis by operation.

Preliminary studies showed collapse of the fontanel with lumbar puncture. Indigo carmine introduced by ventricle puncture through the fontanel appeared in the urine in about four minutes. Uroselectan studies showed normal position and form of the kidney pelves and the appearance of the radio-opaque substance within the normal time.

Operation was done October 16, 1933, according to the technic described. In this instance the arachnoid was carefully picked up and included in the sutures. The opening in the dura was about one centimetre by three millimetres in size. The child went through the operation in excellent condition.

The patient showed an immediate post-operative increase in temperature which went as high as 104.6° rectal, and remained elevated practically continuously until death, seventeen days after operation. There was a high polymorphonuclear leucocytosis. The fontanel remained fairly tense for four or five days and then became depressed. (Fig. 6.) Two days after operation many red cells and innumerable white cells were found in the urine. Within three days the red cells had disappeared but pus continued to be present. In addition a number of granular and cellular casts were observed. It is to be noted that at post-mortem the remaining kidney showed no signs of inflammatory reaction. During the febrile period a thorough search was made daily for the cause of temperature but nothing could be found. No subarachnoid puncture and no post-operative dye test were made. The patient died seventeen days after operation without an exact diagnosis of the cause of death being made, although meningitis was suspected. The wounds had healed *per primam.*

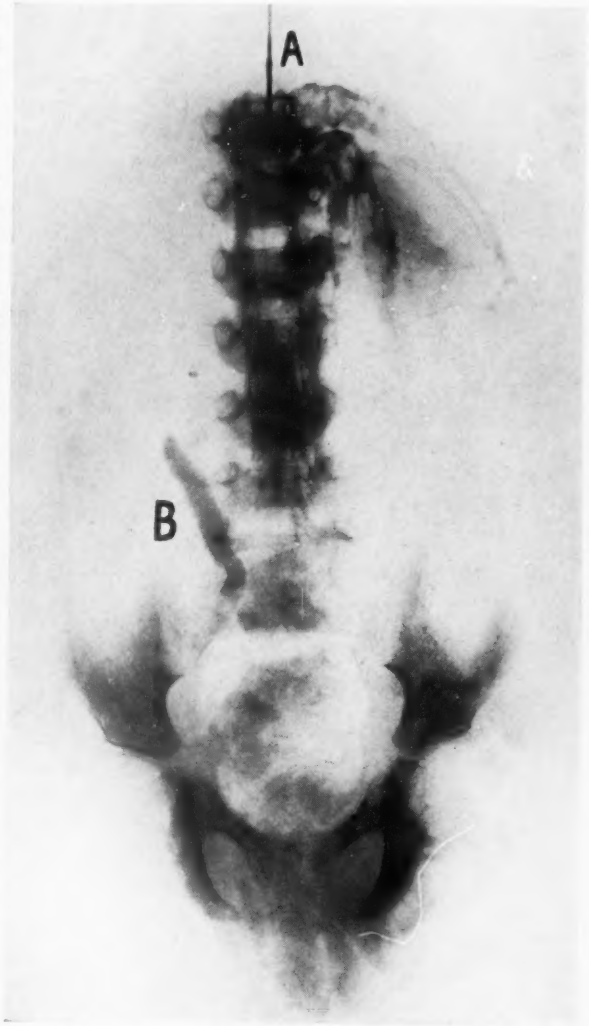

FIG. 7.—(Case II.) X-ray of the post-mortem specimen. (A) is the shadow of the needle in the subarachnoid space and (B) the shadow of the ureter distended with a solution of sodium iodide.

We were able to obtain complete disposal of the body. Before the anatomical examination, an attempt was made to demonstrate radiographically the functional con-

dition of the anastomosis by the injection of sodium iodide into the ventricle. No shadow was seen except in the region of the cranium. The body was then divided transversely in the lower thoracic region. A needle was introduced into the subarachnoid space and sodium iodide was injected. An excellent passage of the iodide into the ureter could be seen in the gross, as well as on the X-ray film. (Fig. 7.)

The important findings at post-mortem, exclusive of the region of the anastomosis, were as follows: The remaining left kidney was slightly larger than would be expected in a child of this age. Microscopically, it showed evidence of hypertrophy but none of infection. There was a marked internal hydrocephalus which at the time of examination was non-communicating. India ink injected into the cisterna magna stopped

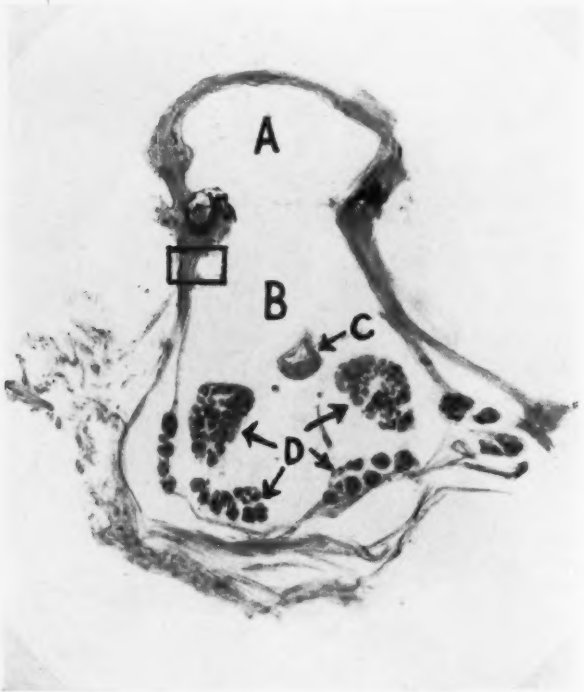

FIG. 8.—(Case II.) Low-power horizontal photomicrograph through the anastomosis. This section happens to pass through sutures on each side of the anastomosis. (A) Cavity of the kidney pelvis; (B) subarachnoid space; (C) arrow points to the filum terminale which has a dilated central canal; (D) arrows point to elements of the cauda equina. The exit of a nerve root is seen at the right. The rectangle indicates the relative position of the photomicrograph shown in Fig. 9 which was not taken from this particular section through the anastomosis.

at the level of the fourth ventricle. The explanation for this probably lies in an acute meningitis which was present throughout the cord and beneath the brain and brain stem. Although an operative source must be suspected, yet the origin of this meningitis is not entirely clear inasmuch as the operative wounds were perfectly clean and many of the silk sutures employed in the anastomosis showed an aseptic healing reaction. The underlying cause for the originally communicating hydrocephalus could not be made out.

The region of the anastomosis was embedded *in toto* in celloidin and was studied in serial sections. It showed a remarkably satisfactory union with a wide open anastomosis.

In a transverse section across the line of anastomosis (Fig. 8) the outer layers of

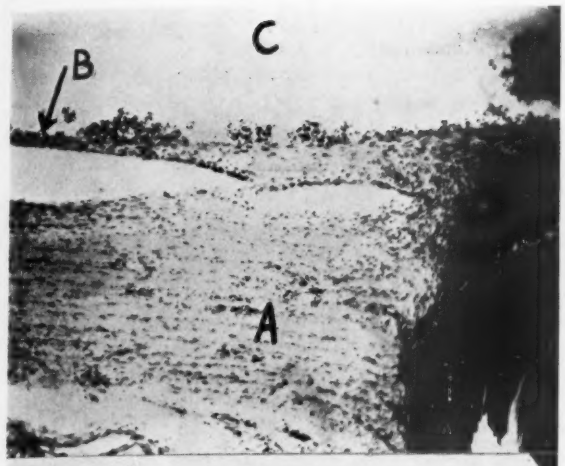

FIG. 9.—(Case II.) Photomicrograph just anterior to the line of anastomosis, showing the adherence of the arachnoid to the dura when the former is properly caught in the suture. The black mass at the right is a silk suture which can be seen to have healed in cleanly. (A) Dura; (B) arachnoid covered with a small amount of acute exudate; (C) subarachnoid space.

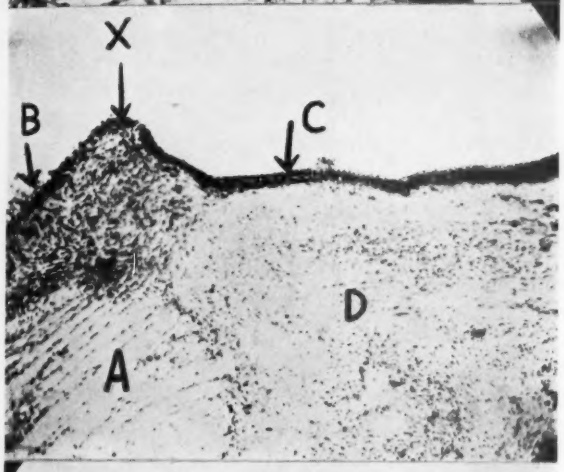

FIG. 10.—(Case II.) Photomicrograph demonstrating the relationship of the epithelium of the kidney pelvis to the cut edge of the dura. (A) Fibres of the dura the limits of which to the right can be clearly seen; (B) surface of adherent arachnoid; (C) epithelium of the kidney pelvis; (D) musculature of the kidney pelvis. At the point X the pavement cells of the arachnoid and the epithelium of the kidney pelvis unite. In all sections studied this point of junction is exactly opposite the cut edge of the dura.

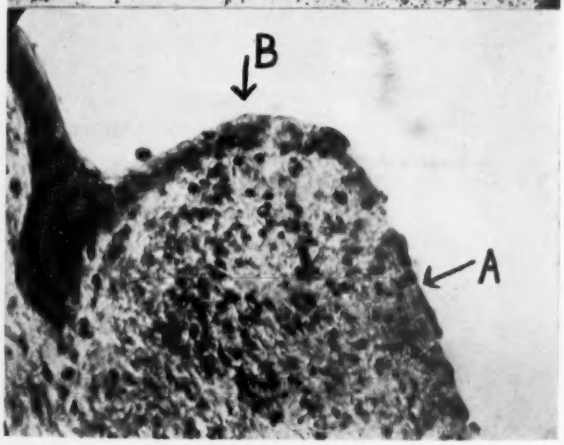

FIG. 11.—(Case II.) High power of the point of junction of the two tissues. (A) Pavement cells of the arachnoid; (B) epithelium of the kidney pelvis. The appearances are those of growth equilibrium. The tongue of pelvic epithelium shown at the left is not present in other sections and therefore probably represents a tangential section of an accidental fold rather than growth activity.

the kidney pelvis can be seen to be firmly united to the dura. The cavity of the kidney pelvis is widely open into the subarachnoid space. The gross relationships of the anastomosis can be clearly seen. In this section and under higher power (Fig. 9), adhesion between the arachnoid membrane and the inner surface of the dura is seen as one approaches the line of anastomosis. This adhesion is the result of the inclusion of the arachnoid in the suture line. The low-power microscopical picture makes clear the importance of this step in the operation. The structure of the arachnoid can be traced from the first point of its attachment to the dura as far as the beginning of the epithelium of the kidney pelvis. The latter in all instances stops opposite the easily identified cut end of the dura. (Fig. 10.) When with still higher power one studies the covering cells at the junction of the two tissues one can clearly make out the pavement type of cell normally lining the inner surface of the arachnoid up to the point where it makes contact with the kidney epithelium. (Fig. 11.) At this point the latter consists of two or three layers of flattened epithelial cells without evidence of piling up. No mitoses were found. The histological picture at the inner surface of the anastomosis is that of a healed wound without growth activity. Collateral evidence of cessation of growth is presented by the fact already mentioned, that the kidney epithelium in all sections studied has not grown into the spinal canal as judged by its definite and constant relationship to the cut edge of the dura. It is impossible to imagine any later stenosis at the level of the anastomosis. This is all the more remarkable in this instance because of the presence of meningitis. Evidences of infection are entirely limited to the spinal canal. (Fig. 9.) There is no evidence of infection about the line of anastomosis and most of the silk sutures show the normal reaction of aseptic healing. (Fig. 9.) A few sutures have polymorphonuclear leucocytes about them. It is interesting to note how completely the silk exposed within the subarachnoid space is covered with a one-cell or two-cell layer of flat cells apparently derived from the inner lining of the arachnoid. Here again healing seems to have reached an equilibrium.

Case III.—(University of Virginia Hospital No. 94113.) A white female child of two years was born in this hospital December 4, 1931, with the use of low forceps. Except for icterus neonatorum the child was entirely normal. She was readmitted October 25, 1933.

Since the age of nine months the child has been seen from time to time in the pædiatric clinic suffering from eczema. Height and weight have been normal, but the head has been noted to be somewhat large. During recent months the child has appeared restless, fretful and is incessantly striking its head, against the floor or some other object, or with the fist. The child did not walk until nineteen months of age and has never learned to walk well. There is no control of urine or of fæces. The child has never talked. Examination showed evidence of injury to the face and head by the fingers. The head measured 50.7 centimetres in circumference with a biparietal diameter of 14.8 centimetres. The frontal and parietal bosses were prominent. The anterior fontanel was open, measuring two centimetres in diameter. There was a definite cracked-pot sound and slight exposure of the scleræ above the cornea. There were no abnormal neurological signs. The patient was definitely feeble-minded.

A ventriculogram was done by the resident October 26, 1933. Under ether anæsthesia, a ventricle puncture was made in the right posterior parietal region through a burr hole. The ventricle was entered without difficulty and twenty cubic centimetres of fluid were allowed to flow out before the injection of one and a half cubic centimetres of indigo carmine. The procedure was not entirely satisfactory inasmuch as considerable dye escaped through the puncture hole. It was thought that possibly the needle had been dislodged from the ventricle before the injection. At the end of five minutes a slight bluish tint appeared in the fluid obtained from the lumbar sac. The flow of fluid was so free that in spite of the poor dye return a diagnosis of communicating hydrocephalus was probable.

On account of doubt, however, an encephalogram was done. Eighty cubic centimetres

of fluid were easily removed by lumbar puncture and seventy-five cubic centimetres of air injected. The encephalogram showed air over the cortex in the region of the puncture hole. On account of the absence of cerebral markings it was believed that this air was probably in the subdural space, being the result of the technical error in ventricle puncture four days previously. The other findings showed dilatation of the lateral and the fourth ventricles without air in the sulci over the cortex. It was interesting that after each lumbar puncture the child for several hours would become quiet and cease to strike the head.

The definite demonstration of a communicating hydrocephalus, the apparently favorable clinical effect of reduction in pressure by lumbar puncture, and the problem that the child was presenting to her parents, made worthwhile an attempt at permanent spinal drainage. It was thought that perhaps the relatively slight degree of internal hydrocephalus might make the prognosis favorable if the operation was successful.

Uroselectan studies showed normal position and shape of the kidney pelves and normal appearance time of the shadow. The urine was normal.

The operation of uretero-arachnoid anastomosis was therefore done November 3, 1933. In this instance the child was too restless to permit local anæsthesia for laminectomy and the entire procedure was done under light drop ether. The operation followed closely the description already given. The arachnoid was carefully included in the suture. The pelvis of the kidney bifurcated outside the substance of the kidney, a condition not detected in the uroselectan studies. It was found that the inferior portion of the pelvis offered an adequate amount of tissue for the anastomosis. The superior portion of the pelvis was therefore doubly ligated and amputated without constricting the lumen of the ureter. The patient went through the operation in excellent condition.

The post-operative course in this case was entirely smooth. The patient's temperature reached 102° rectal the afternoon of operation; thereafter it went no higher than 100.2°, reached normal on the third day and remained normal thereafter. The wounds healed per primam. The child gained weight steadily and seemed in excellent condition. There was no improvement in her mental condition, and she continued to strike her head frequently. November 20, 1933, seventeen days after operation, one and one-half cubic centimetres of indigo carmine were injected into the spinal canal. The dye was seen through the cystoscope to appear twelve minutes later from the right ureteral orifice. There was no color from the left orifice. The child's urine, three days after operation, was normal and remained so thereafter. She was discharged November 25, 1933, twenty-two days after operation, apparently in excellent condition although without improvement in emotional and mental state.

The baby was readmitted to the hospital in desperate condition, ten hours after discharge. She had been taken about twenty to twenty-five miles in an automobile. As soon as the automobile started she began to vomit and had vomited uninterruptedly since. The child died within three hours of readmission, apparently of acute dehydration. Examination at this admission showed nothing except a loss of fourteen ounces of weight in ten hours. There were no convulsions and no neurological changes. Vigorous attempts were made to replace fluid but without effect.

Unfortunately, no post-mortem was permitted. The cause of the persistent vomiting is not clear unless it be the rapid loss of cerebrospinal fluid from sudden increase in function of the anastomosis associated with the vibration of the automobile.

Discussion.—Before attempting an evaluation of this operation in the light of the above experience, I should like to propose the modification of the name for the procedure suggested in the title of this contribution. The union of the epithelium of the kidney pelvis with the arachnoid membrane is theoretically the essential step in the operation. The subarachnoid space

and the lumen of the pelvis must be made continuous. Suture of the pelvis to the dura is entirely incidental, being important only technically in obtaining firm union. Hence the term "uretero-arachoid anastomosis" rather than "uretero-dural anastomosis" will remind the surgeon of the essence of the procedure. I have not suggested an even more accurate term, namely "pyelo-arachnoid anastomosis" because, in the first place, no fundamental principle is subserved by the use of the pelvis instead of the ureter and, in the second place, it is well not to depart too far from the name originally given by Heile lest confusion rather than clarity result.

In evaluating any operative procedure one must first consider operative mortality. As already stated, the operative mortality in the cases I have been able to collect is close to 20 per cent. My operative mortality is nil up to the seventeenth day. Then death occurred from meningitis in one case (Case II). In the thirteen cases collected by Kartava[14] there was one operative death. To judge by the behavior on the operating table of my three cases, shock should not be an important factor, particularly if the laminectomy is done under local anæsthesia. One of my cases (Case II) presented as poor a risk for prolonged operative manipulation as one would care to assume. Kartava feels that the risks of the operation have been magnified. Even if one must accept an operative mortality of 20 per cent. in a group of cases that certainly average below normal in nutrition and vitality, one must remember the higher mortality and the great morbidity of the untreated case. If convinced that the operation offers a real promise of arrest of this distressing condition, the operative mortality should prevent no surgeon from adopting the procedure.

In considering any plastic operation involving transplantation of tissue, one is interested both in the successful accomplishment of the ends sought by the transplantation and in the structural and functional defects left at the site from which the transplant is removed. The necessity to sacrifice a normal kidney has received much comment in the literature. Granting that this is undesirable, we must nevertheless recognize that there are a multitude of individuals, normal in health and habits, whose excretion is well handled by a single hypertrophied kidney. There should be no hesitancy in choosing between unilateral nephrectomy with resulting cure of hydrocephalus and bilaternally retained kidneys in a hopeless hydrocephalic.

The danger of meningitis following infection of the urinary tract has also been much discussed. The problem of ascending infection from the bladder in the absence of urinary obstruction is an unsettled one. In one of my cases (Case II) the child died of meningitis. At post-mortem there was no evidence of pyelitis; infection was limited to the meninges, introduced probably at the time of operation. Again, it seems to me, there should be no hesitancy in adopting an operative cure for hydrocephalus to which is added a somewhat problematical risk of meningitis.

To sum up the argument to this point, no objection of real importance can be brought forward against the operation of uretero-arachnoid anastomo-

sis, provided it can be expected to arrest the progress of hydrocephalus. On this point the evidence is indefinite. Clinical experience has not yet been extensive enough to warrant judgment. The technic has been unstandardized, often faulty. No one man has performed enough operations to be certain either of his technic or of his results. The possibility of spontaneous arrest of the disease has not been sufficiently considered in dealing with results. In Case I, I believe that the operation may have been life-saving in tiding the patient over the period during which he was developing the compensation he has now probably acquired. Perhaps by keeping intracranial pressure low for a period of weeks, it aided in the reopening of old channels and hence in the establishment of compensation. On the other hand, there is fairly positive evidence that his anastomosis is no longer functioning. Hence in the sense that a permanent bypath for excess fluid had been established this case cannot be considered a successful one. Such a situation is not discussed by other authors. In both Cases II and III, death occurred too soon to judge more than the immediate results.

We have, then, no way yet to judge whether or not we are on the right path leading towards the arrest of hydrocephalus. Only with a much larger experience will this enlightenment come. The real question at issue in the present phase of the history of this operation is whether we are justified in seeking this experience on the actual patient. We are certainly so justified, considering the relatively hopeless nature of the disease, provided first that there is reason to believe that a permanent drainage of cerebrospinal fluid can be obtained, and second that such permanent drainage is not in itself harmful. The first of these provisions brings us back to the technical question that has snagged every other operation directed towards the same end. Permanency of uretero-arachnoid anastomosis depends on patency of the anastomosis itself and patency of the ureter. The tissues from Case II present indisputable evidence that, properly performed, the anastomosis will not necessarily heal across. Cystoscopical examination in Cases I and III demonstrate normal ureteral peristalsis nineteen and seventeen days, respectively, after operation. Certainly the ureter should not be expected to lose its functional activity later. Nor would one expect that scar contracture in the muscle tunnel would become more effective later. In other words, the available evidence suggests that the hitherto insuperable technical problem of continuous spinal fluid drainage is close to solution in this operation. It is probable that in a certain proportion of cases a permanent fistula will be established. Case I presents evidence against this view. Here a fistula was demonstrated at nineteen days, and could not be demonstrated at seven and one-half weeks. However, it must be remembered that this was a first operative experience in which the importance of the rôle of the arachnoid membrane was not realized.

The second provision presents a serious problem. Is it deleterious to a point incompatible with life to lose cerebrospinal fluid continuously? In the absence of infection a post-operative or post-traumatic cerebrospinal fluid

fistula is well tolerated. The loss of fluid, however, rarely lasts over weeks. The problem is probably not one of loss of vitally necessary substance not replaceable, like water and salt, by increases in dietary intake. It is rather one related to the pressure changes and consequent anatomical and functional deformities of the already handicapped central nervous system resulting from the loss of fluid. It is not supposed that Case III died of dehydration due to loss of cerebrospinal fluid, but rather from dehydration from repeated vomiting caused by cerebral irritation, which in turn resulted from loss of cerebrospinal fluid. All this is rather hypothetical, but it must be kept in mind, particularly as a number of cases have died quite suddenly and unexpectedly about three weeks after operation. Case III is an instance in point, as is Kartava's case. In both instances the operation was apparently successful and had been perfectly tolerated. The reason for such deaths must be found. If they are found to lie in loss of cerebrospinal fluid, then it is obvious that, except for operations on the choroid plexus, internal communicating hydrocephalus is an incurable disease.

But we have not yet reached that conclusion. The point is not settled. Uretero-arachnoid anastomosis offers technical advantages in the relief of hydrocephalus by continuous drainage. Its disadvantages, such as the attendant nephrectomy, are inconsiderable in view of the seriousness of the disease. There is no real evidence that loss of cerebrospinal fluid is harmful. There is no clinical evidence worth careful weighing that bears on the results of the operation. Such evidence will accumulate only with more widespread adoption of a theoretically meritorious procedure. In spite of the discouraging results in the three cases reported I do not feel that the operation in my hands has yet had a fair trial. After further experience it may become obvious that the venture is a mistaken one. Not yet is that proven.

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TREATMENT OF CARCINOMA OF THE THYROID GLAND

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In recent years an apparently increased incidence of malignancy of the thyroid gland has revived the interest of pathologists and surgeons in the subject, and, in consequence, impressive advances have been made in knowledge of the disease. The earlier teaching that benign thyroid tumors are capable of metastasizing, a feature considered peculiar to malignant tissue, and that carcinoma of the thyroid gland differs in certain biological characteristics from carcinoma of other organs, gave rise to confusion and served to envelop the disease in a veil of mystery not shared by carcinoma situated elsewhere. Much of the mystery has been dispelled through the efforts of a number of investigators, notably C. H. Mayo, Balfour,[1] Wilson,[19] Crotti,[8] Coller[6] and others, in emphasizing the frequency with which malignancy develops in preëxisting benign nodules; Graham,[11] in recognition of the tendency of certain encapsulated malignant tumors to invade the veins and thus to metastasize by way of the blood-stream, and Simpson,[18] in his brilliant exposition of the fallacy of the teaching that benign thyroid tumors undergo metastasis. Largely as the result of these investigations, most pathologists today are in accord that there exists no basic difference in the biological characteristics of malignancy of the thyroid gland and malignancy elsewhere of similar type and grade; however, there is still marked division of opinion among surgeons and clinicians as regards prognosis. It is apparent that the fatalistic attitude is more widespread concerning this disease than concerning malignancy of other organs of equal accessibility to surgical attack. It is because of the prevalence of this attitude of despair that it seems especially worthwhile to review the cases of malignancy of the thyroid gland seen at The Mayo Clinic in the hope of stimulating greater interest in the problems of treatment.

Incidence.—From 1910 to 1934, 658 patients with malignancy of the thyroid gland were seen at The Mayo Clinic. In 406 of these cases diagnosis was made from microscopical study of the specimen of the tumor removed at operation, and in 252 the obvious clinical diagnosis of inoperable carcinoma was not proved by biopsy. Because of the difference in the years included in the cross index of the clinic, the records of the operative cases of malignancy of the thyroid gland date from January 1, 1907, and those of the nonoperative from January 1, 1910.

A study of the ratio of malignant thyroid tumors to operative cases of goitre each year does not show any definite trend, except of a moderate increase during the years since 1928. This increased incidence probably is not

actual but relative, and is accounted for by the tendency of patients with benign goitre to defer operation because of the economic depression.

Of the 658 patients, 421 were females and 237 males, a ratio of 1.77 to 1. In the same period, the sex incidence for all nodular goitres was about five females to one male. The age incidence in this series corresponds to that of carcinoma situated elsewhere, 72 per cent. of the patients being within the fifth, sixth, and seventh decades of life; however, it is worthy of emphasis that two patients were less than ten years of age, and nine others less than twenty years of age.

The high incidence with which carcinoma develops in preëxisting benign thyroid tumors has been emphasized by nearly all writers who have investigated the subject. In a previous analysis of part of this series (276 cases), it was estimated that the malignant neoplasm originated in a preexisting goitre in 87 per cent. of the cases. Likewise, because of this fact, it is generally conceded that there are no signs or symptoms by which early malignant changes can be recognized, for commonly it is only after the carcinoma has perforated the capsule of the gland and invaded the surrounding structures that a positive clinical diagnosis can be made. As previously pointed out, estimation of the basal metabolic rate of a patient with a thyroid tumor throws no light on the differential diagnosis of malignancy. This applies to the different types of malignancy as well as to the group as a whole. Thus, of the eighty-three patients with papillary adenocarcinoma in which cases the metabolic rate was estimated, the rate was found normal for fifty (60 per cent.); above normal for twenty-four (29 per cent.); and below normal for nine (11 per cent.). Of the sixty-six patients with malignant adenoma, the rate was normal for thirty-seven (56 per cent.); above normal for twenty-six (39 per cent.); and below normal for three (4.5 per cent.). Of the forty-eight patients with diffuse adenocarcinoma, the rate was normal for twenty-two (46 per cent.); above normal for eighteen (37 per cent.); and below normal for eight patients (17 per cent.).

There is wide variation in the histopathology of malignancy of the thyroid gland, and because of a definite, although not constant, relationship between the clinical course of the disease and the pathological features of the growth, many attempts at classification have been made. Although in some instances the microscopical picture of one type may seem to merge with that of another, most pathologists and surgeons agree that there are distinctive features which lend themselves to, at least, clinicopathological grouping. Curiously enough, the different classifications vary, for the most part, as regards nomenclature rather than as regards the essential features. The following classification has been used in The Mayo Clinic for many years, and has been found adequate for the grouping of all the cases of primary malignancy of the thyroid gland: (1) papillary adeno-carcinoma; (2) adeno-carcinoma in fœtal adenoma (malignant adenoma); (3) diffuse adeno-carcinoma; (4) epithelioma; and (5) sarcoma.

It is not my purpose to discuss these types and varieties of malignancy at length, but for clarity of meaning I desire to point out their distinguishing morphological and clinical features and to suggest such modifications of the principle of treatment as my experience indicates are applicable in each group. Because, in some instances, the microscopical picture of malignancy may imitate benign changes of the thyroid gland, pathologists have experienced difficulty in its interpretation. Appreciating this difficulty, Graham[11] studied a large series of cases of tumor of the thyroid gland and concluded that vascular invasion constitutes an absolute, and, with some encapsulated nodules the only, criterion of malignancy. Although the accuracy of Graham's observations is not questioned, many pathologists experienced in this

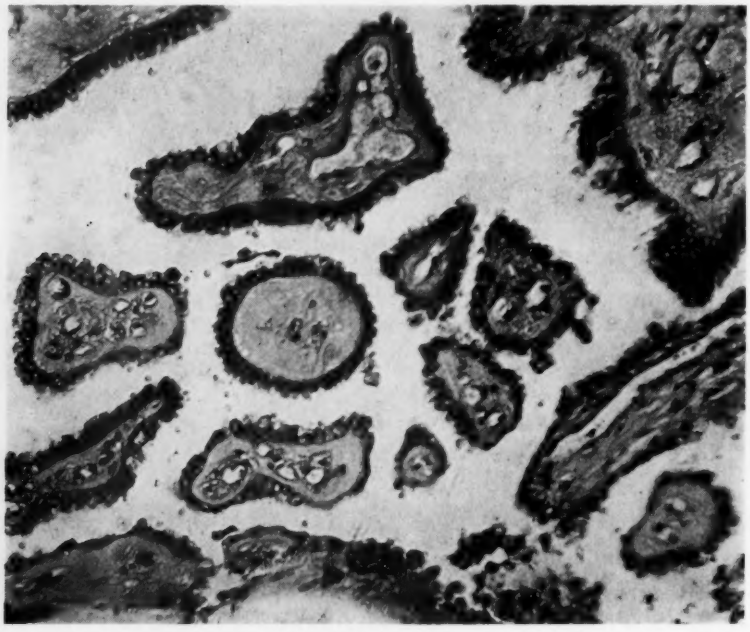

FIG. 1.—Papillary adeno-carcinoma, grade 1.

field of study are agreed that this finding of vascular invasion is not necessary to the microscopical diagnosis of malignancy of the thyroid gland. Instead, they rely on the presence of the usual criteria of malignancy elsewhere in the body, that is, anaplasia or cellular dedifferentiation.

TYPES OF MALIGNANT TUMOR.—*Papillary Adeno-carcinoma.*—This tumor is readily distinguishable histologically from other types of malignancy by its papilliferous structure. (Fig. 1.) Commonly, its origin is in a preëxisting benign tumor, but occasionally the absence of a history of long standing and the absence of an encapsulated or partially encapsulated nodule suggest that it may arise from a non-goitrous gland. These tumors always are of a low grade of malignancy, grade 1 or 2, yet they reveal a marked predilection for invading the lymph spaces and spread to involve a cervical lymph-node, or commonly a chain of cervical lymph-nodes. Not infre-

quently the size of the metastatic tumor greatly overshadows the primary tumor, and at operation the primary tumor may be overlooked if the character of the cancerous nodes is not recognized. Even in neglected or recurrent cases, in which the condition is inoperable because of fixation of the growth, rarely does distant metastasis occur. In its biological characteristics, there is a close analogy between this type of carcinoma of the thyroid gland and the papillary adeno-carcinoma of the ovary. As the patient with papillary adeno-carcinoma of the ovary with extensive peritoneal implants may live many years in good general health after removal of the primary tumor, so also may the patient live who has papillary adeno-carcinoma of the thyroid gland with extensive cervical metastasis, provided the danger of erosion into, or compression of, the œsophagus and trachea has been elimi-

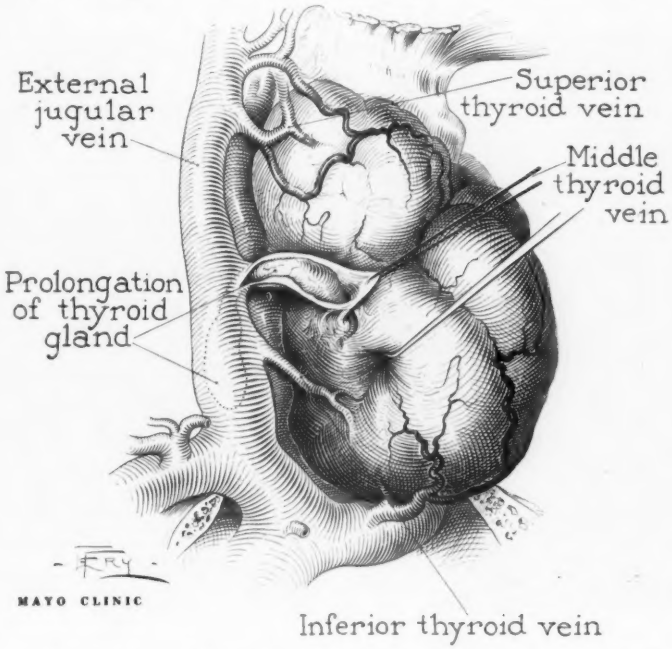

FIG. 2.—A cord-like prolongation of carcinomatous tissue projecting through the middle thyroid vein into the internal jugular vein. The patient is living and well four years after thyroidectomy.

nated by removal of the primary growth. Furthermore, both are of low grade of malignancy, and both are radiosensitive, which is not a property, for the most part, of carcinomas of low grade situated elsewhere.

Aberrant Papillary Carcinoma.—Not infrequently, malignant tumors of thyroid structure occur in the neck, separated from the thyroid gland. These are found above the superior pole of one lobe of the thyroid gland, along the line of the great vessels, or in the posterior cervical triangle. Their origin is not known, but most observers believe that they arise from benign tissue that has been misplaced because of some defect in the embryological development of the thyroid gland. My experience with these tumors has led me to believe that they probably do not originate from misplaced thyroid

tissue, but, on the contrary, that they are deposits of malignant cells which originated in the thyroid gland. The scope of this paper does not permit full exposition of my views regarding their origin, but one of the reasons for my belief that they are really secondary to malignancy of the thyroid gland is the fact that malignancy of lateral aberrant thyroid tumors is always limited to a single type, that is, papilliferous adeno-carcinoma, which, as already has been mentioned, has a predilection for spreading by way of the lymphatic structures or by direct implantation. The frequency with which these tumors are found to be associated with a similar type of malignancy of the thyroid gland proper, and the fact that they always are on the same side of the neck as the malignant growth of the thyroid gland, are further evidence in favor of their metastatic origin.

FIG. 3.—The carcinomatous adenoma removed in the same case as that represented in Fig. 2.

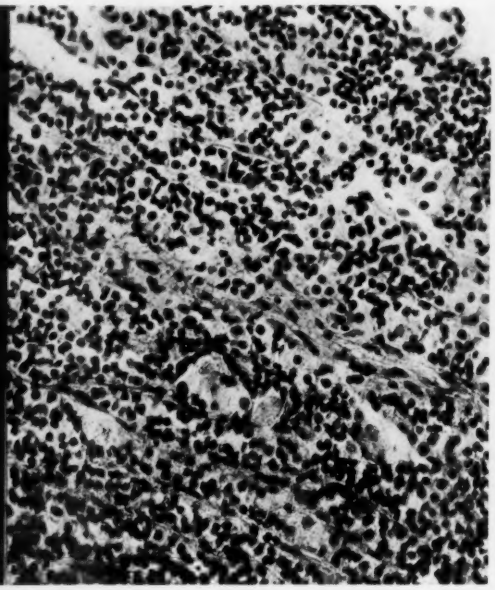

FIG. 4.—Microscopical appearance of the tumor in the same case as that represented in Figs. 2 and 3.

The diagnosis of aberrant thyroid carcinoma was made in fifteen cases in which operation was performed at The Mayo Clinic. Of this number, carcinoma also was demonstrated in the thyroid gland in five cases. Of the remaining ten cases in which carcinoma of the thyroid gland was not demonstrated, in only three was the thyroid gland explored.

Adeno-carcinoma of Fœtal Adenoma (*Malignant Adenoma*).—As the term implies, this type of tumor arises from malignant transformation of benign "fœtal" adenomas. Commonly the tumor is single, but it may be multiple. Its morphology is not uniform but varies within wide limits. In some cases, the structure of the follicles is preserved in whole or in part, and, in others, the follicular arrangement is completely lost, presenting a picture of branching columns of undifferentiated cells. For the most part,

these tumors are of low grade of malignancy, grades 1 and 2, but occasionally tumors of grade 3 occur. Unlike papillary adeno-carcinomas, tumors of this type do not spread by way of the lymph vessels until the capsule of the tumor is invaded, but on the contrary tend to metastasize early by way of the blood-stream. This feature sometimes can be demonstrated at operation by the presence of sizable masses of carcinomatous tissue in the veins about the thyroid gland. (Figs. 2, 3 and 4.) Since invasion of the capsule does not occur until late, the malignant change in these tumors is commonly not suspected before operation unless distant metastasis has been discovered.

Diffuse Adeno-carcinoma.—This type of tumor (Fig. 5) may arise within a preëxisting benign nodule or from a non-goitrous gland. It presents as wide a variety of cellular changes and histological patterns as tumors of similar grades of malignancy situated elsewhere. In the higher grades of malignancy, in which the follicular structure is completely lost, the arrangement of the rapidly growing cells, small, round, spindle-shaped or giant, may simulate the picture of sarcoma. Not only have tumors of this type been mistaken for sarcomas, but pathologists confronted with two dissimilar pictures in the same tumor, one resembling sarcoma and the other carcinoma, have considered the process a compound one and have termed it "carcinoma-sarcomatode." The acute, fulminating malignant growths of the thyroid gland are represented by this type. Metastasis occurs by way of the lymph vessels, or blood-stream, or both.

Squamous Epithelioma.—This type of tumor (Fig. 6) of the thyroid gland is exceedingly rare, and whereas its origin is commonly ascribed to extensions from the œsophagus, trachea, or thyroglossal duct, Broders[3, 4] considers that the tumor may arise directly from the thyroid gland by metaplasia of the epithelium. Primary epithelioma of the thyroid gland occurred in three cases, in all of which patients died within a year of the operation.

Sarcoma.—Because of the close microscopical resemblance of certain carcinomas to sarcomas, some pathologists, notably Ewing,[10] have questioned whether sarcoma (Fig. 7) ever occurs in the thyroid gland. Although the incidence as reported in the literature is probably far too high, sarcoma nevertheless has been positively diagnosed at The Mayo Clinic in four instances in the course of pathological examination of approximately 40,000 thyroid glands. All of the four patients died within a year of the operation.

The principles of treatment of malignancy of the thyroid gland should be considered according to the stage of its development, that is, the operable case, the inoperable case, and the benign adenoma as a precursor of malignancy.

Operability.—Of the 406 cases in which patients with malignancy of the thyroid gland were operated on at The Mayo Clinic from January, 1910, to January, 1934, an endeavor was made to extirpate the tumor in 321 cases and biopsy alone was performed in eighty-five. The 321 patients undergoing

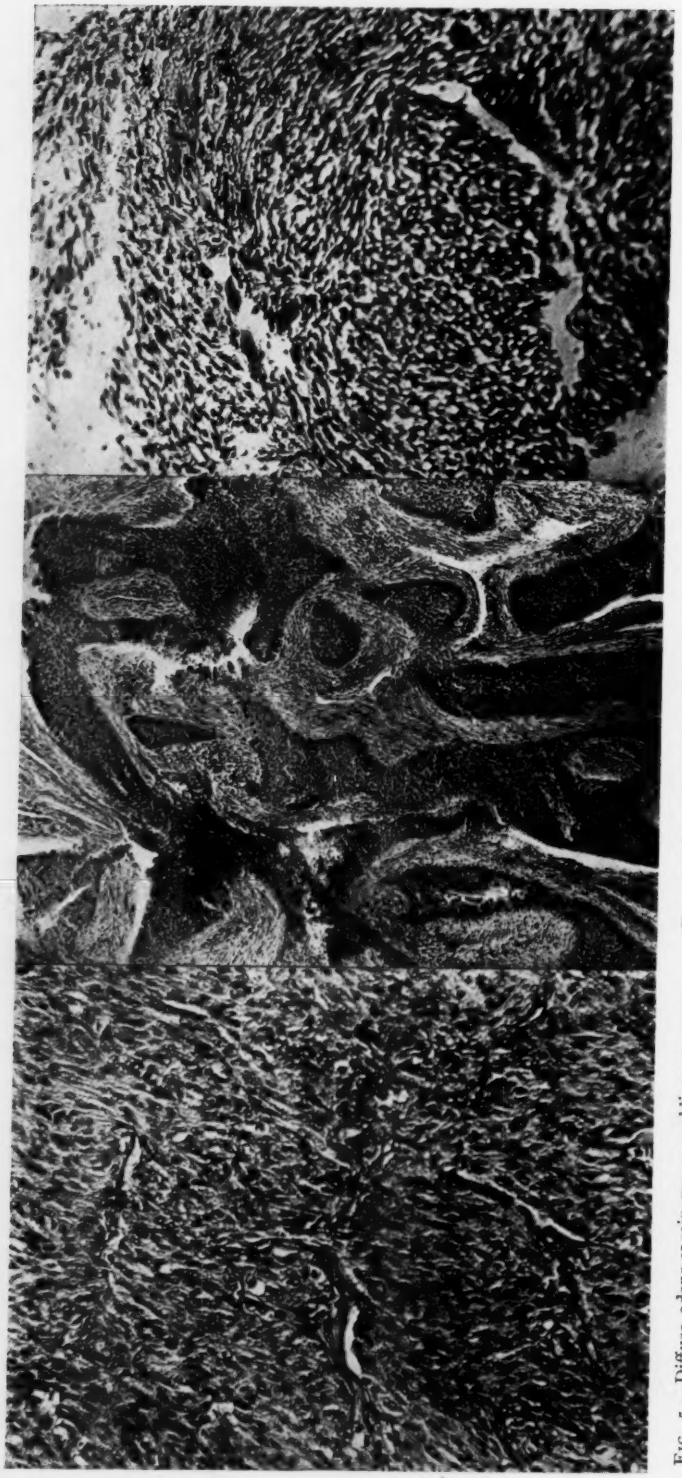

FIG. 5.—Diffuse adeno-carcinoma resembling sarcoma. FIG. 6.—Squamous-cell epithelioma, grade 3. FIG. 7.—Fibromyxosarcoma.

partial thyroidectomy represent 48.8 per cent. of all patients (658) with carcinoma of the thyroid gland seen during this period.

Operability of carcinoma of the thyroid gland depends on the extent of the local invasion of the primary lesion and on the absence of distant metastasis. In the absence of distant metastasis, the relative fixation of the tumor is the important feature, to be considered in determining operability. Tumors which are completely fixed to all the contiguous structures should not be operated on, for it is obvious that the risk of extirpating the tumor is out of proportion to the amount of benefit that one could hope to obtain. However, if the mobility is limited in such a way as to suggest that the carcinoma has perforated the capsule of the gland at one place only, then exploration is justifiable, for not infrequently in such instances the tumor can be removed in its entirety. Even when the tumor cannot be removed completely, radium can be directly applied to the small fragment of carcinoma that is left attached. This procedure is especially applicable in cases of extensive carcinoma of the papillary adenomatous type; in this series there are several patients who have lived for many years in good health and without evidence of recurrence of the malignancy following partial removal of the primary lesion, supplemented by irradiation. The significance of carcinomatous involvement of the cervical lymph-nodes, as regards operability, varies according to the type of malignancy. Unless the type is the low-grade papillary adeno-carcinoma, I consider it very doubtful if radical removal of the carcinomatous process is ever justifiable. However, if the malignancy is of the papillary adeno-carcinomatous type, metastasis to the cervical nodes does not constitute a contra-indication to radical removal of the primary lesion together with the involved nodes. On the contrary, if the primary lesion is operable, operation can often be undertaken at small hazard, and with good prospects of effecting cure.

The appearance of enlarged (carcinomatous) cervical nodes months or years following removal of a malignant thyroid tumor, in the absence of a recurrent tumor in the thyroid gland, has not the same prognostic significance as the occurrence of enlarged nodes following operation for malignancy situated elsewhere. Here, it indicates that the primary lesion was of the papillary adeno-carcinomatous type, and if the involved nodes are confined to the neck, then surgical removal offers a reasonable chance of cure. The following two cases, briefly summarized, illustrate the value of secondary removal of carcinomatous cervical nodes:

REPORT OF CASES.—CASE I.—A woman, aged forty-nine years, registered at the clinic April 29, 1925. Examination revealed an adenomatous goitre, involving the right lobe of the thyroid gland, which the patient stated was of sixteen months' duration. Operation was performed March 5, 1925, and pathological examination of the tissue removed disclosed papillary adeno-carcinoma, grade 2. Extirpation of the right lobe was performed and, later, treatment with radium and Röntgen-rays was given.

The patient returned to the clinic March 19, 1928. Examination at that time disclosed an enlarged lymph-node at the anterior edge of the right sternomastoid muscle. Operation was performed March 24, and the pathologist reported tissue removed to be

papillary adeno-carcinoma. Treatment with Röntgen-rays and radium was given following operation. Examination of the patient in 1934 gave no evidence of recurrence of the malignancy.

CASE II.—A woman, aged thirty-seven years, registered at the clinic July 16, 1928. She complained of a swollen gland in the right cervical region of four years' duration. Examination revealed two nodules, one measuring about three by two centimetres in the middle portion of the right cervical region, and the other in the right submaxillary region. The nodules were removed and grossly seemed to be aberrant thyroid tissue. It seemed advisable to explore the right lobe of the thyroid gland at this time. Accordingly, this was done and two small, pea-sized nodules were removed from the upper part of the right lobe of the thyroid gland. The remainder of the lobe was normal. The pathologist reported the tissue to be papillary adeno-carcinoma, grade 2. Treatment with radium was given following the operation.

The patient returned November 8, 1928, because of recurrent nodules in the posterior triangle of the right side of the neck. A diagnosis of metastastic carcinoma of the thyroid gland was made, and block dissection of the right side of the neck was performed. The pathologist reported adeno-carcinoma grade 2. Treatment with radium was given following the operation.

Examination of the patient in 1930 gave no evidence of recurrence, and in a letter received in May, 1934, she stated that she was in excellent health.

In carcinoma of the thyroid gland, as in carcinoma situated elsewhere, the occurrence of distant metastasis in bone, pulmonary tissue, and so forth, precludes every possibility of curing the disease by any known method of attack on the primary lesion and, therefore, constitutes an absolute criterion of inoperability. However, the presence of distant metastasis in a case of malignant adenoma which is producing tracheal compression should not alone be considered a definite contra-indication to operation. Removal of the obstructing goitre will afford immediate relief, and the patient may live to enjoy many years of useful life. As pointed out by Ewing[10] and Simpson,[18] metastatic malignant thyroid tumors may undergo such marked differentiation as to simulate benign thyroid tissue. Because of this characteristic, the tumor is slow in growing, and unless it involves some vital structure, may not seriously impair the health of the patient for many years. The following case, previously reported by Harrington,[12] illustrates this feature:

CASE III.—A woman, aged thirty-five years, came to the clinic October 31, 1923, because of a goitre which had been present for fifteen years and which had increased in size about ten years before admission. Examination gave essentially negative results except for indicating the presence of a multiple nodular goitre unassociated with hyperthyroidism, and the presence of an old, calcified tuberculous lesion at the apex of the left lung, which was revealed in a röntgenogram. Partial thyroidectomy was performed November 6. Microscopical examination of the goitre revealed adeno-carcinoma, grade 2 (Fig. 8) in an encapsulated colloid and fœtal adenoma.

The patient returned September 11, 1929, because of a severe pain in her back of a year's duration. She had had an indefinite pain in the epigastrium and back and indigestion for three years previous to her second visit. She had been operated on elsewhere for a diseased gall-bladder, but the gall-bladder had been found normal; the appendix had been removed at this time, and the round ligament of the uterus shortened. Following this operation, the pain and indigestion had persisted, and a year previous to her second visit to the clinic the symptoms had been getting progressively more severe. The pain had been constant and dull, with acute attacks of sharp pain which had been pro-

jected around both sides of the lower portion of the thorax to the epigastrium. Röntgenological examination gave evidence of marked destruction of the left half of the fifth, sixth, and seventh thoracic vertebræ due to erosion caused by a tumor. The regularity of the shadow in the röntgenogram suggested the possibility of a benign tumor, but the history, as well as the severity of the pain, suggested the diagnosis of metastasis to the spinal column from a tumor of the thyroid gland. Treatment was deferred in order to see if time would make differential diagnosis possible. Three months later the patient returned and stated that marked general improvement had occurred. Her appetite had improved and she had gained 8½ pounds (3.8 kilograms). January 18, 1930, Doctor Harrington performed posterior left mediastinotomy and, on exploration, found a mass involving the fifth, sixth, and seventh thoracic vertebræ. The mass was removed in part, and the pathologist reported adeno-carcinoma of the thyroid type (Fig. 9), which had differentiated into columnar epithelium to a large extent, and bore a close resemblance to exoph-

FIG. 8.—(Case III.) Adeno-carcinoma, grade 2, in a colloid and fœtal thyroid gland.

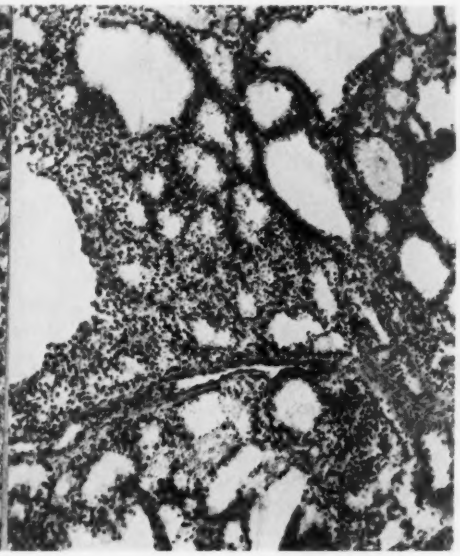

FIG. 9.—(Case III.) Adeno-carcinoma, grade 2, of thyroid type from the thorax. Differentiation into columnar epithelium has taken place to a large extent. The specimen bears a close resemblance to exophthalmic goitre.

thalmic goitre. The patient made an uneventful convalescence, and although she derived no apparent benefit from the operation, the fact that she was alive as lately as August, 1933, is further clinical evidence of the low grade of malignancy.

Theoretically, the surgical procedure in malignancy of the thyroid gland should consist of wide removal of the primary growth, together with the regional lymphatic structures, but experience has proved that extirpation of the cervical nodes, unless there are reasons to suspect that they are actually involved, is seldom necessary in order to obtain the greatest benefits. The latter part of this statement, because it is at variance with the basic principles on which rests the surgical treatment of malignancy in general, deserves a word of explanation. Carcinoma of the thyroid gland, with the possible exception of the papillary type, seldom spreads by way of the lymph-vessels until it has penetrated the capsule of the gland. If the growth is of

the papillary type and has invaded the capsule, exploration of the cervical nodes on the affected side should be carried out and the nodes extirpated if found enlarged. Growths of high grade of malignancy, which have invaded the capsule, are commonly inoperable because of extensive fixation, and hence removal of as much of the primary lesion as possible, followed by irradiation, will accomplish as much as a more radical operation which includes removal of the cervical lymph-nodes.

Commonly, the operable carcinoma is completely encapsulated, which accounts for the fact that in so large a percentage of cases the malignant nature of the tumor is not suspected before operation. I consider that wide removal of these tumors is a sufficiently radical procedure. If the carcinoma is not definitely encapsulated, the operative procedure calls for total removal of the affected lobe. It is only for a very limited group of bilateral infiltrating carcinomas that removal of the entire thyroid gland is indicated.

If the carcinoma is not definitely encapsulated, a large, rubber drainage tube is left in the cavity, so that later (twelve to forty-eight hours) radium may be inserted directly in the wound. Subsequently, in all cases, after the wound has partially healed, topical application of radium and treatment with Röntgen-rays are given.

INOPERABLE CARCINOMAS OF THE THYROID GLAND.—In my experience, the best results of treatment of inoperable carcinoma of the thyroid gland have been obtained by combined radium and Röntgen therapy. The technic of its administration has been given in papers by Bowing,[2] and by Pemberton and Fricke,[17] and, therefore, it will not be discussed here except to clarify one phase. Although it is probable that the imbedding of radium needles directly into the tumor has advantages over topical application, I do not believe that these advantages are sufficiently great to warrant surgical exposure of the thyroid gland in all cases of inoperable malignancy. This procedure, therefore, has been limited to those cases in which either the operability or the diagnosis cannot be determined by clinical methods of examination. Since, in my experience, malignancy of the thyroid gland, treated by irradiation alone, is confined to the advanced inoperable cases, actual cures are hardly to be expected. Yet, the marked diminution in the size of the tumor, which not infrequently follows irradiation treatment, and the fact that 10 per cent. of the patients live for five years or longer, are convincing evidence that malignant growths of the thyroid gland are exceedingly radiosensitive. This fact, alone, justifies its use as an adjunct in all operable cases.

THE QUESTION OF OPERATION FOR BENIGN ADENOMA.—My views regarding removal of a benign adenoma in order to prevent the development of carcinoma subsequently have not materially changed in recent years. In view of the fact that carcinoma of the thyroid gland develops in from 80 to 90 per cent. of the cases in a preëxisting benign adenoma, and in view of the known frequency of carcinoma of the thyroid gland, should all adenomatous goitres be considered precursors of carcinoma and their removal urged?

That the retention of adenomatous goitre entails a certain risk of carcinoma cannot be denied. The extent of the risk cannot be accurately estimated in the light of our present knowledge of the actual and relative incidence of benign and malignant tumors of the thyroid gland. I believe, however, that this danger is sufficient to be taken into account in formulating an opinion as to the advisability of removal of a simple nodular goitre, and in view of the exceedingly low operative risk and morbidity, and the very small incidence of recurrence of adenomatous goitre after operation, I believe that we are warranted in stating the facts to the patient and in advising operation. Furthermore, the fact must be appreciated that since there are no clinical signs to indicate the presence of malignant changes in 50 per cent. of all operable cases, so likewise there is no assurance that a tumor of the thyroid gland is benign. When these dangers are considered in conjunction with the other potentialities of a retained adenoma, that is, development of hyperthyroidism and extension of the growth, I believe that with proper hospital facilities, and in the absence of specific contra-indications, we should urge removal of all tumors of the thyroid gland.

RESULTS.—In order that statistics of the results of treatment may be truly representative, the series from which results will be estimated includes all cases of carcinoma of the thyroid gland in which operation was performed at The Mayo Clinic from January 1, 1907, to July 1, 1928. Since five years, at least, have elapsed in each case since operation, the figures may be considered as fairly accurate indexes of end-results. My colleague, A. C. Broders,[3] has reviewed the histopathological findings for each specimen, and has classified and graded the neoplasm according to the degree of malignancy. In fifty-six of these cases the operation was limited to removal of only a specimen of the growth for pathological study and grading. All of these fifty-six patients subsequently received irradiation treatment. In the remaining 267 cases (82.66 per cent.), the operation for removal of the malignant growth consisted of partial or almost complete thyroidectomy with or without removal of cervical lymph-nodes. Eleven of the 323 patients died in hospital, a mortality rate of 3.4 per cent. Of the remaining 312 patients, 137 (43.9 per cent.) have lived five years or longer, and sixty-four, or nearly 20 per cent., have lived more than ten years. Of the 137 patients who have lived five years or longer, the treatment for ten (7.3 per cent.) consisted of irradiation alone, and for 127 (92.7 per cent.) of radical removal with or without post-operative irradiation. Tables embodying some of these results have been published by Dixon and me[16]; other data are included in Table I, published in the present paper.

Because of the high percentage of the relatively low grades of malignancy, (71 per cent. of the tumors were graded 1 or 2), and because of the peculiar radiosensitiveness of carcinoma of the thyroid gland, in many cases of inoperable carcinoma, and in many of those in which there is local recurrence, the growth can be reduced in size or held in abeyance for many years without serious impairment of general health. Thus, of the 137 cases in which

TABLE I

Malignancy of the Thyroid Gland

End-results in 267 Cases in Which Thyroidectomy Was Performed with or without Post-operative Irradiation (January 1, 1907, to July 1, 1928)

Outcome	Papillary Adeno-Carcinoma		Carcinoma in Adenoma or in Fœtal Adeno-Carcinoma		Diffuse Adeno-Carcinoma		Sarcoma		Total	
	Cases	Per Cent*	Cases	Per Cent*	Cases	Per Cent*	Cases	Per Cent*	Cases	Per Cent*
Lived less than 5 years	24	30.00	38	34.86	33	49.25	2	66.66	97	37.45
Lived 5 to 9 years	18	22.50	25	22.93	20	29.85	1†	33.33	64	24.71
Lived 10 years or more	29	36.25	26	23.85	8	11.94			63	24.32
Dead, time not known	1		3						4	
Not traced	8		17		6				31	
Died in hospital			4		4				8	
Totals	80	29.96	113	42.32	71	26.59	3	1.12	267	
Patients living 5 years or more	47	58.75	51	46.78	28	41.79	1	33.33	127	49.03

* Based on total patients less those who died in hospital.

† On rechecking the histopathological features of the specimen in this case, Doctor Broders now concludes that the process is one of thyroiditis.

patients have lived five years or longer, local recurrence or persistence of the malignancy was present in forty-two, and its presence or absence was unknown in twenty-three. However, it is kown that seventy-two, or 24.35 per cent. of all the patients treated, lived without evidence of recurrence of carcinoma for five years or longer. All of the seventy-two patients who lived five years or more and are known to be free of recurrence were subjected to thyroidectomy, and they represent 27.76 per cent. of all the patients so treated.

The pre-operative diagnosis of malignancy was made or suspected in 134 cases (41 per cent.). Of this group, subtotal thyroidectomy was performed in eighty-four cases (63 per cent.) and biopsy in only fifty cases. Because of the opinion expressed by many writers that treatment is of little value in cases of carcinoma of the thyroid gland in which the diagnosis can be made pre-operatively, it is of interest to check the results in this group. Of the 134 patients, thirty-four, or 25.4 per cent., lived five years or longer; twenty-five were of the eighty-four who had undergone partial thyroidectomy and nine were of the fifty who had undergone biospy and received irradiation.

The value of surgery in malignant tumor of the thyroid gland with cervical metastasis is illustrated by the results obtained in eleven cases in which block dissection of the cervical lymph vessels was carried out. These

represent all the cases in which block dissection has been done in association with malignancy of the thyroid gland and constitute 2.6 per cent. of the 426 cases of thyroid malignancy in which operation was performed. Of these eleven patients, one is untraced, two lived less than twenty months, and two died of recurrent carcinoma five and eleven years later, respectively. The remaining six patients are all living and well, one a year, one five years, one six years, one seven years, one nine years, and one eleven years, respectively, after the operation.

SUMMARY.—The most effective treatment of malignant neoplasms of the thyroid gland is the combination of surgery and irradiation. Because of important biological differences, treatment of primary malignant tumors should be considered in accordance with the type and grade of malignancy. The distinguishing clinical features of papillary adeno-carcinoma are the low grade of malignancy and the tendency for the disease to spread to regional lymphatic structures, where it may be confined without further dissemination for many years. Metastasis to the cervical lymph-nodes is not a criterion of inoperability in this type, for radical surgical removal of the primary lesion, together with the involved nodes, and in conjunction with post-operative irradiation, offers a good chance for cure.

The essential clinical features of adeno-carcinoma in fœtal adenoma are, commonly, the low grade of malignancy and the tendency for early dissemination of the carcinoma by way of the blood-stream. Since lymph vessels are not involved until after the carcinoma has invaded the capsule, the presence of cervical metastasis in this type has a far graver prognostic significance than in the former. The presence of distant metastasis should not necessarily be construed as a contra-indication to surgical removal of an encapsulated and obstructing malignant adenoma. Because of the tendency of metastatic malignant thyroid tissue to undergo marked differentiation, a single metastatic tumor may not seriously impair the health of the patient for years.

The diffuse adeno-carcinomas of the thyroid gland are of higher grades of malignancy than the preceding types, and behave as diffuse adeno-carcinomas situated elsewhere. Squamous epithelioma is rare and is highly malignant. The three patients in this series with this type of growth died within a year of the operation. Sarcoma of the thyroid gland is very rare. The four patients in this series with this type died within a year of the operation. The operability for the entire series of 658 tumors was 48.8 per cent. The results in 323 cases of malignant tumor of the thyroid gland in which patients were operated on in The Mayo Clinic before July 1, 1928, are tabulated according to the type and grade of malignancy. Of the fifty-six patients treated by irradiation alone, ten, or 18.86 per cent., lived five years or more, and of the 267 patients who underwent partial thyroidectomy with or without post-operative irradiation, 127, or 49.3 per cent., lived five years or more. Adenomatous goitre is a precursor of malignancy in a high per-

centage of cases and, therefore, a potential risk of malignancy should be considered in every case of nodular goitre.

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DISCUSSION.—DR. EDMOND M. EBERTS (Montreal, Canada).—Doctor Pemberton, unfortunately, is unable to be here to read his paper. I was to have offered some remarks on my own experience, and, if you are willing to listen for a few minutes, I will tell you something of our experience in the treatment of malignant disease of the thyroid gland in the Goitre Clinic at the Montreal General Hospital.

During the last ten years, the period in which the clinic has been in active operation, we have investigated 3,400 cases of goitre, including all varieties, many of them being the

ordinary adolescent or endemic type. Of this total number 1 per cent. were malignant. Of these 3,400 cases, 1,825 were subjected to operation, and, applying the percentage to this limited number, we found that 2 per cent., or thirty-four cases, were malignant.

In the larger group were included three patients who had been operated upon elsewhere. These cases were investigated, but it was found that nothing further could be done.

If one restricts the group to the nodular type, in which 1,050 operations have been performed, the incidence of malignant disease is 3 per cent.

One might further segregate these cases; 730 cases of primary Graves' disease have been treated by operation and two showed early malignant neoplasia. Malignant disease in Graves' disease is rare. In one European report on 4,500 cases of Graves' disease, no cases of malignant neoplasia were encountered. Doctor Tinker has reported such a case, and there are a few others in the literature.

In deciding whether a lesion is definitely malignant or not, one must bear in mind that the thyroid presents a very definite difficulty. The ordinary criteria of malignancy do not here apply as they do in other organs. We owe a debt to Graham, who, ten years ago, in 1923, pointed out that the only uncontrovertible proof of carcinoma in these cases is the presence of capillary invasion.

In our two cases of carcinoma in Graves' disease there was no capillary invasion. In some of the other cases that we have reported cases that present all the ordinary histological features of carcinoma and which have been definitely classified by Dr. Laurence Rhea as malignant, this feature of capillary invasion has not been demonstrable. The fact is that, while these are malignant, they are at the same time a benign type, a type in which the process is slow in its extension and metastasis is late, and they are par excellence the type susceptible to radiation.

Of the thirty-four patients treated, there are three upon whom we have no recent note but who are assumed to be alive. There are twenty-one reported living, the postoperative period varying from a few months to thirteen years; and there are thirteen dead. In these latter cases the lesion was in every instance advanced, with not only infiltration of the capsule of the precursory adenomatous lesion but also involvement of the prethyroid muscles, and in two of the cases definite metastasis to the neighboring lymph-nodes.

While a metastasis, of course, signifies the third stage of the disease, it is by no means a contra-indication to operation. We have one patient, a girl who was first seen at the age of thirteen, in whose case the diagnosis on the original operative material was "multiple benign adenomata," who later developed metastasis, was subjected to a second operation, and subsequently to radiation, and is well at the end of twelve years.

We have had three instances of malignant disease in the second decade. Doctor Tinker has stated that in his opinion malignant disease of the thyroid in young subjects is on the increase. It is a mistake to assume that malignant disease may not occur before the fourth or fifth decade.

Now in regard to the susceptibility to radiation. The susceptibility appears to vary with the histological type, the papillomatous type being the most favorable, the adenocarcinoma occupying the middle strata, and the least favorable being the infiltrating scirrhous type. These scirrhous cases do unquestionably arise in glands that previously have shown no evidence of disease. There are a number of cases now reported.

There is no reason, of course, why scirrhous carcinoma should not occur in the thyroid, but the favorable feature about thyroid malignant disease is that it nearly always arises in a precursory adenomatous lesion which has been present from six to thirty years before malignant change occurs. That, of course, is a reason why one should advise the removal of an adenoma, although apparently benign.

Where early malignant change is taking place in an adenomatous lesion, there are no clinical signs, and the diagnosis is made either at operation on gross section or on micro-

scopical examination. It is very important, I think, that all tissues removed in these cases should be subjected to a thorough histological examination. Sections from different areas of an adenoma should be examined, because one may otherwise very easily overlook the presence of early malignant change. We did so ourselves in three instances in our early experience, and I know that the condition has been overlooked in other cases referred to us with recurrence in the neck, the original histological diagnosis having been benign adenoma.

In 1927, I reviewed this subject, reporting fourteen cases, and at that time was able to collect in the literature 1,876 cases of malignant thyroid disease. Since that time the number has probably been doubled. From the receipt of a small statistical publication from The Mayo Clinic, I know that Doctor Pemberton was to have presented to you his experience in the treatment of a very large series.

A palliative operation to relieve respiratory embarrassment is justifiable in certain instances, although the case may be hopeless from the point of view of surgical cure or even cure from the use of radium or X-ray.

I would then stress, Mr. Chairman, as the most important features: (1) that in 90 per cent. of cases the disease develops in a precursory adenomatous lesion; and (2) that early secondary malignant change is not clinically detectable and for this reason all adenomata should be removed.

Kocher, the younger, states that the prognosis in early papillary carcinoma developing in benign adenomatous lesions where pre-operative clinical evidence of malignant disease is absent is extraordinarily favorable, practically all cases making permanent recoveries. But even in those of the adeno-carcinomatous type, the removal of the lesion, followed by X-ray therapy, very greatly prolongs life, even in the unfavorable cases with local lymph-node metastases. The expectation of life is usually from five to six years with possibly local recurrence during this period, which may be attacked either surgically or with X-ray. But that is about the limit—six years. The favorable cases are those that pass the six-year period; they are then fairly safe for the future.

DR. FRANK H. LAHEY (Boston, Mass.).—I think, there are two or three things which are of value from our experience with the malignancy of thyroid which might be useful to others. I want to call to your attention particularly the lesion which will be very disturbing to anyone who has not had experience with it; that is, the lateral aberrant thyroid. If you have not dealt with this surgically, you will certainly be surprised at their appearance, bluish black, and if you are not conscious of the fact that they are potentially malignant and extremely radiosensitive, you may do the wrong thing for them. We have had seventeen of them. Two have died from malignancy. They should be treated by radical dissection followed by radiation.

All carcinoma in the thyroid in our experience has been divided into three groups: the papillary adenoma, which is very radiosensitive; the adeno-carcinoma, which tends to recur first locally and then distantly; and the giant-cell carcinoma and the small round-cell carcinoma which is extremely malignant.

I particularly wish to call your attention to the operability and prolongation of life in the first group. We have seen several of these patients with a neck full of papillary adeno-carcinoma who seemed utterly hopeless, yet on demonstration it has been the type which under radiation has become discrete, movable and at times removable.

For that reason, I think no patient with malignancy of the thyroid should be denied the right of biopsy in the determination of the type, because if you know it is papillary adenomatous type you may have a patient like the one we had that I saw just before coming here, now eight years after removal. Originally this patient had a neck entirely full of cancer; yet eight years later following radiation and after biopsy she has only a dense scar which is firm and movable.

I think it is interesting to remember that the age of the patient and the size of the adenoma is not security against the onset of malignancy. We have had a boy of twelve

die of malignant degeneration in an adenoma and have seen an adenoma the size of one's little fingernail which had degenerated into an adeno-carcinoma.

DR. CHARLES H. FRAZIER (Philadelphia, Pa.).—Of course it is quite true, as the speakers have emphasized, that those tumors which are composed of cells essentially immature, with very little differentiation, respond most promptly to radiation and in a most extraordinary fashion. There are cases on record in which tumors have disappeared within eighteen hours of the time radiation was applied and experiments have been carried on in which, as I recall, there was definite evidence of cell necrosis within three hours of the time the treatment was applied.

There is this extraordinary contrast between the effect of radiation upon thyroid tumors and upon brain tumors. In thyroid tumors, those composed of the most immature cells respond most promptly to radiation; whereas in brain tumors those composed of the most immature cells respond not at all. Those of us who have had any experience at all with the X-ray treatment of brain tumors know that the most malignant of all brain tumors, the so-called spongioblastoma, composed essentially of immature cells, is unaffected, so far as we know, by radiation.

THYROID SURGERY AS AFFECTED BY THE GENERALIZED USE OF IODIZED SALT IN AN ENDEMIC GOITRE REGION—PREVENTIVE SURGERY

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THE chemical composition of the earth's surface as well as its physical contour has gradually changed through the ages and it is still being changed by erosion and by the washing out of the soluble compounds from the land and their transference to the sea. The soil is also exhausted by agriculture unless that agriculture is scientifically done. Some civilizations that have attained great heights have probably fallen because their soil became exhausted by their crops and the inhabitants had no suspicion of the possible reason or the means of its prevention. Early plant and animal life on the earth probably grew under chemical temperature and radiant energy conditions very different from those of today and the changing chemical make-up of the soil and water probably had profound effects on our evolution. Certainly it is not only the anatomy of animals and plants that has changed.

As the halogen group of elements occur in rather soluble compounds it is natural that ocean water is rich in these compounds and that great areas of land have gradually been depleted of them. Today scientists are reclaiming bromine from sea water on the North Carolina coast in large quantities. As the agricultural scientist is attempting to replace in the fields depleted chemicals it is of interest to read this year of the successful attempts of a Swiss physician[1] in replacing iodine in the soil of his garden thereby raising vegetables richer in iodine content which in turn have proven of value in the prevention of endemic goitre.

Although ancient peoples made pilgrimages to the seashore for seaweed and though burnt sponge[2] was used in the treatment of goitre in the thirteenth century it was not until 1812 that Courtois discovered the element iodine and not until 1895 that Baumann[3] discovered the normal presence of iodine in the thyroid gland. Sporadic attempts had been made both in France in 1860[4] and in Switzerland to treat endemic goitre with iodized salt. Breuer, Kocher,[5] Halsted and others came to the belief that iodine might do more harm than good and attempts to follow through with its use received a setback. Iodine hyperthyroidism (Jodt Basedow) was described by Breuer in 1900.[6]

The work of Marine and his associates awakened a new interest in iodine and goitre. In 1907 Marine reported that iodine is necessary for the normal functioning of the thyroid and that in colloid goitre the amount of iodine present was reduced. He found that if the store of iodine in the thyroid fell below .1 of 1 per cent. the thyroid gland would enlarge. He and his

associates found out that the iodine store could be increased by the addition of small quantities of iodine by any one of several methods. This arrested the hypertrophy of the gland and the thyroid cells returned to their resting form. In 1928[7] Marine reports: "As a result of the numerous studies of the relation of iodine to the thyroid gland our present views regarding the cause of goitre assume that it is a compensatory hypertrophy of the thyroid depending on a relative or absolute deficiency of iodine. This deficiency of iodine may be due to: (1) Factors which bring about an abnormally low intake of iodine; (2) factors which interfere with the absorption or utilization of an otherwise adequate intake; (3) factors which increase the needs of the body for the iodine containing hormone." The chief factor under number one is the lack of iodine in the food and water supply. Factors under number two are not so well known though there have been recent papers on this subject. Under number three—it is common knowledge that the thyroid is prone to enlarge at puberty, at menstruation, during pregnancies and sometimes in cases of malnutrition and with infections.

Our own experience in Detroit in an endemic goitre region in treating adolescent children with enlarged thyroids with sodium iodide tablets before 1924 showed that the thyroid which enlarged at menstruation did not enlarge after the regular use of iodine. The same satisfactory effect was present in the use of sodium iodide in controlling the enlargement of the thyroid during pregnancy.

That certain articles of food may cause rabbits to develop goitre has been shown by Chesney and Webster[8, 11] when they fed animals on a diet rich in cabbage. When these animals, however, are given additional iodine, the goitre will not develop. McCarrison[12] has for years advocated the infectious theory of goitre and cites an instance of the clearing up of an endemic goitre area in India by substituting a pure water supply for the polluted water supply. An explanation of this may possibly depend again on iodine supply. There is an instance of the opposite effect as cited by Marine and Kimball[13] when a pure water supply from the Cascade Mountains was given to Portland, Oregon, Seattle and Tacoma, Washington. This new water supply was deficient in iodine. Crotti[14] is the leading exponent of the infectious theory in this country.

Iodized salt was first introduced to the public in Michigan in 1925 as a prophylactic measure against endemic goitre. There were, of course, prophets who predicted a dire outcome and there was some foundation for their belief based on the earlier teachings of Breuer, Kocher, Halsted and others, but there was no foundation in actual experience in Michigan.

Michigan lies in one of the two greatest although mild endemic goitre areas of the United States.[15] Surveys of the incidence of endemic goitre have been made in different sections of Michigan by Olin,[16] and Kimball and Slemons. Serious consideration of the goitre problem in Michigan was the result of the findings of the draft boards during the World War: "Goitre was so prevalent that in some groups as high as 30 per cent. of the persons were

incapacitated for army service, owing to disqualifying toxic goitres in 583 registrants."[17] There were many interesting findings in these surveys—a few miles separation was often marked by a tremendous difference in the incidence of goitre. At Mount Clemens, Michigan, 26 per cent. of the children had enlarged thyroids while at Romeo, Michigan, twelve miles distant 75 per cent. of the children had enlarged thyroids. The water supply at Mount Clemens contained twenty-five parts of iodine per billion while at Romeo the water supply contained not a trace of iodine in fifty litres.

Michigan Experience.—Ten years will soon have passed since the introduction of this salt with iodine and we can check on the results of its use. Through coöperation of the Michigan State Medical Society, the State Board of Health, Dr. O. P. Kimball, and the salt manufacturers iodized salt was introduced in 1924 through the grocery stores without any legislative law. Wide publicity of this effort was obtained at that time through letters from the State Board of Health to school children, parents, and organizations. In the clinic of the Henry Ford Hospital we had for a number of years previous to this been treating non-toxic diffuse goitre (simple colloid) in children with sodium iodide tablets with such uniformly good results and no bad results that we believed in the probable efficacy of iodized salt distributed in this manner if it were universally accepted.

Iodized salt in Michigan contains .01 per cent. of sodium iodide. The committee from the Pediatric section of the State Society recommended that the use of this salt should preclude the use of any other form of iodine and to be effective that it should be used for cooking as well as for table use. The salt producers estimated that each inhabitant of Michigan on the average consumed between five and six pounds of salt a year, whereas other estimates placed the consumption at eight pounds per year per individual. The committee accepted the eight pounds per year as a safe average. This would give the average consumer about one milligram of sodium iodide per day.

The iodine content of the thyroid gland, which gland contains over three fourths of the iodine in the body, varies in different geographical areas from 2.4 to 23.7 milligrams with an average of eight milligrams. Orr and Leitch[4] claim the minimum iodine requirement of the body to be about forty-five gammas for an adult and 150 gammas for a child per day. A gamma is 0.000001 Gm. A grain is 0.064 Gm. or 64,000 gammas. As two or three milligrams of sodium iodide per week will prevent goitre and ten milligrams has been proved to do no harm, the average percentage derived from the Michigan iodized salt lies well within safe limits.

Extent of Use of Iodized Salt in Michigan.—A letter from the largest salt distributor in Michigan (September 1, 1931) states that "in 1924 we shipped 45,079 cases of plain table salt to the State of Michigan. In 1930, 58,643 cases of iodized salt and 7,057 cases of plain table salt." Letters from the other large distributing salt companies showed the same ratio of about eight of iodized to one of plain salt. A letter received from a large salt

company shows the following figures for three years of their sales in Michigan.

	Iodized Per Cent.	Plain Free Running Per Cent.
1930	84.8	15.2
1931	87.4	12.5
1932	94.8	5.2

For a few years after the publicity in this matter our patients knew if they were using or were not using iodized salt. Today without the publicity the patient does not know, as a rule, whether he is or is not using iodized salt. Perhaps the lack of publicity too will result in a decreasing use of this

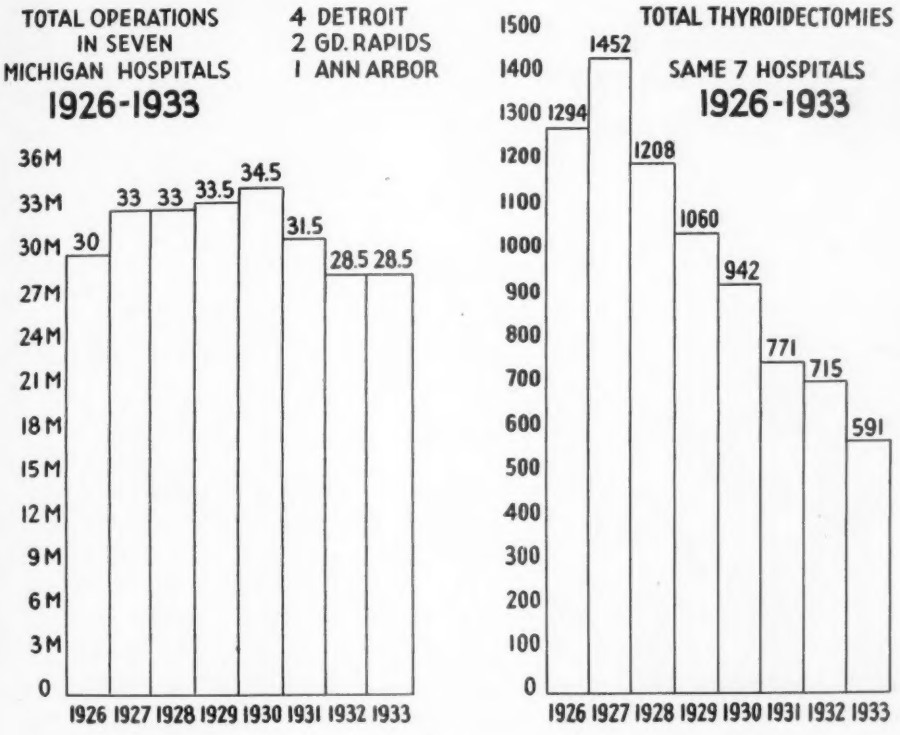

FIG. 1.

salt. Recently a large chain store reported that they are selling only five iodized salt to one plain package.

In 1927 in our clinic there was a gradually increasing number of goitre patients coming to operation in spite of or perhaps because of the introduction of iodized salt. The large majority of the cases were of toxic nodular goitre and we reported our results at that time.[18] The rising curve of operations and the goitre death rate curve in Detroit suggested that the iodine might be harmful and that the experience in Switzerland and France of giving up the use of iodine was correct. However, the iodized salt sales

were under such headway that no effort of discouraging its use was thought of.

During the next few years the number of goitre operations in our clinic fell off so rapidly in spite of an increasing total number of all operations that I was led to ask the seven largest hospitals in Southern Michigan for their statistics. These included University Hospital, Ann Arbor; Harper, Grace, Henry Ford and Receiving Hospitals, Detroit; Blodgett Memorial and Butterworth Hospitals, Grand Rapids. Their figures were freely given to us and curves plotted of each of these and then a composite curve made. (See Fig. 1.)

This curve shows exactly the same results that we were having in our own clinic. In the seven hospitals there were only 591 goitre operations in

FIG. 2.

1933 as compared to 1,452 such operations in 1927 while the total number of all operations during the depression years dropped—a 60 per cent. drop in goitre surgery compared to 17 per cent. drop in all surgical operations.

The yearly death rate from goitre supplied to us through the courtesy of the Detroit Board of Health suggests too that there was some harmful effect the first few years after the introduction of iodized salt. (Fig. 2.)

It should be noticed that the death rate is lower than before the introduction of iodized salt for the greatly increased (doubled) population of Detroit in the eighteen years shown.

The most striking figure (Fig. 3) we present here is that showing the incidence of goitre or enlarged thyroid glands in the children in Detroit schools.

In 1924[19] 35 per cent. of all the Detroit school children showed enlargement of the thyroid. In 1932 only about 1 per cent. had any enlargement of the thyroid. McClendon[20, 21] from the draft board statistics has shown that the incidence of exophthalmic goitres throughout the United States is proportional in every locality to the incidence of endemic goitre. The above two statements have been borne out by our findings as reported here. In this region since the introduction of iodized salt coincident with the great dropping off in the number of enlarged thyroids there has been a dropping off in the number of thyroid operations for hyperplasia and adenomata of the thyroid.

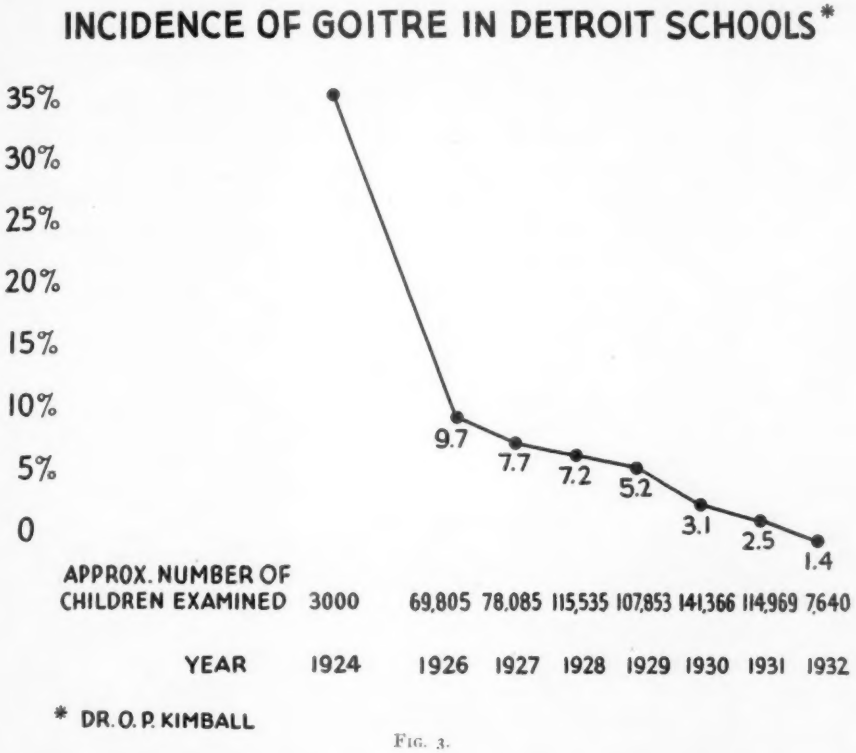

FIG. 3.

DISCUSSION.—As shown in our charts the first year after the introduction of iodized salt in Michigan the rising curve suggests a possible harmful effect and if the iodized salt had been stopped at that time we probably would not have seen the later striking drop in the curve. Kocher in 1904[5] had warned against the indiscriminate use of iodine because of symptoms of hyperthyroidism in adenomatous or nodular type of goitre. Kocher[22] in 1910 and 1911 in papers on Jodt Basedow told of the untoward effects of iodine in exophthalmic goitre. The very name fixed in the minds of his followers the possible dangers of iodine in the treatment of goitre.

From Cleveland in 1926 Hartsock[23] reported that many individuals with goitre are precipitated into a state of hyperthyroidism by the use of iodized

salt but he writes to me in August, 1933: "At the present time we doubt very much if we see any cases that are of this nature, *i.e.*, iodine hyperthyroidism."[24]

Cowie, of Ann Arbor, has been especially interested as one of the responsible committee in investigating several cases of hyperthyroidism supposed to have been induced by the use of iodized salt. He reports: "We have run down several reports of ill effects from the use of iodized salt, but in each instance we have found that the reports were fallacious."

Arnold Jackson[25] reported fifty cases of iodine hyperthyroidism. He also reports:[26] "Simple adenoma is one form of endemic goitre which closely follows colloid goitre in regional distribution. The incidence of adenoma of the thyroid is decreased by the prophylactic treatment of colloid goitre. Apparently adenomas frequently start in neglected colloid goitres as a form of compensatory development. Adenomas rarely cause constitutional symptoms before the patient is twenty years of age unless provoked by iodine medication."

In studying our records we failed to find any goitre patients who had developed iodine hyperthyroidism or Jodt Basedow of Breuer following the use of iodine prescribed by their physicians or the use of iodized salt. Some of our patients with toxic diffuse goitres as well as with toxic nodular goitres became iodine fast or iodine resistant. The improvement stopped and they again became more toxic. The iodine administration was stopped after it failed to hold the improvement as shown by the basal metabolism tests. We then became interested in looking up a group of patients who really received large doses of iodine over a long period of time.*

Can iodine hyperthyroidism be produced in an individual with a normal thyroid with enormous doses of iodine? We believe that this does not occur. We quote reports from two large divisions of syphilis where patients receive huge doses of iodine. Dr. Earl Moore, of the Division of Syphilis of the Department of Medicine at the Johns Hopkins Hospital, reports to me that they have records of over 10,000 patients treated with large doses of iodides with no record of a case developing iodine hyperthyroidism. Dr. Frank Menagh, of the Henry Ford Hospital, reports to me that among 6,000 cases of syphilis treated with large doses of iodides there was only one patient that presented symptoms suggestive of iodine hyperthyroidism and this was very questionable. These patients in our syphilis clinic were, of course, living in an endemic goitre region, so many had mild simple goitre.

Marine and Kimball[13] reported: "The administration of any salt of iodine in any manner completely protects the remaining thyroid against compensatory hyperplasia."

CONCLUSIONS

(1) Iodized salt as used in Michigan did at first apparently increase the number of thyroid operations.

* Authorities pretty well agree that the iodine is readily used by the body whether taken in the form of Lugols, KI, Na.I., hydriodic acid or syrup of ferrous iodide.[27]

(2) The increase was in the nodular goitre or adenoma group, and we believe the iodized salt may have activated a group of quiescent adenomata producing toxic goitre symptoms.

(3) The increase reached its peak in the second year after the introduction of iodized salt.

(4) An increase in the death rate from goitre as shown by the Board of Health statistics reached its peak in the second year after the introduction of iodized salt.

(5) There was no increase in hyperthyroidism excepting in the nodular goitre or adenomata group.

(6) The number of operations for toxic diffuse and toxic nodular goitre has rapidly and steadily decreased after the apex of the second year increase had been reached.

(7) The incidence of endemic goitre or enlarged thyroid has been reduced almost to nil since iodized salt has been so widely used.

(8) We now see no cases which show the slightest ill effects from the use of iodized salt.

(9) Toxic nodular goitre and toxic diffuse goitre are less apt to occur when there has been no previous enlargement of the thyroid (endemic goitre), at least this would seem a safe conclusion based on our experience.

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THE PATHOLOGY AND TREATMENT OF BLEEDING POLYPOID TUMORS OF THE LARGE BOWEL

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The different types of these tumors are:

(1) Adenoma, generally pedunculated but sometimes flat. (Fig. 3.)

(2) Papilloma or villous tumor. (Fig. 6.)

(3) Multiple polyposis—involving whole colon. (Fig. 10.)

(4) Inflammatory polyps, found in amœbic dysentery and ulcerative colitis and other inflammatory conditions.

(5) Carcinoma: (*a*) Grossly resembling flat adenomata. (Fig. 12.) (*b*) Grossly resembling papillomata. (Fig. 15.)

The more important questions to be answered regarding these tumors are whether the benign appearing single adenoma or papilloma is a premalignant growth, and what constitutes the criteria of malignancy in them. Until we have a clearer conception of the fundamentals of malignant tumor growth the question must be begged, but consideration of the clinical course of these tumors and their pathological aspects give us some ability to evaluate the problem. The statement is frequently heard that all adenomas and papillomas of the large bowel will eventually become malignant. This is based in part on the overwhelming evidence of development of carcinoma in nearly all cases of multiple polyposis, where the entire colon and rectum is studded with polyps of all types—flat and pedunculated adenomas and large and small papillomas; it is based in part on the histological appearance of very early invasion of the basement membrane in papillomatous tumors which appear benign. (Figs. 8 and 9.) Clinically, it is based partly on the appearance of certain carcinomata of the large bowel which take on an adenomatous or papillomatous character and project into the lumen of the bowel without evidence of superficial ulceration which characterizes the usual ulcer of adeno-carcinoma (Figs. 12 to 15), and it appears probable because of the frequent findings of flat and pedunculated adenomas in the colon which is already the seat of a typical carcinoma. (Figs. 1, 2 and 3.)

Contrary to the above evidence, that all of the adenoma and papilloma are premalignant, is the frequent finding of these tumors in the colon at autopsy, where they have existed for an indefinite time without undergoing malignant degeneration; further, it is an extremely rare clinical experience to observe what to all appearances is a single benign adenoma or papilloma in the rectum becomes clinically malignant over a considerable period of observation; further, what appear to be flat adenoma grossly and histologically occasionally come on the exposed mucosa of a colostomy and then disappear. (Crops of papillomata have been seen to disappear when the bowel was sidetracked by colostomy and the fæcal stream diverted.) Lastly, pedunculated adenoma is

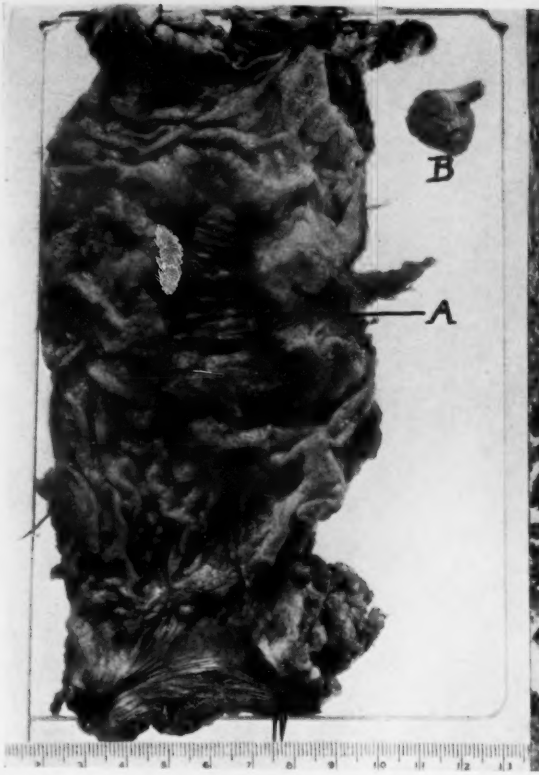

FIG. 1.—(A) Adeno-carcinoma of the rectum, removed by a one-stage abdominoperineal operation. (B) Pedunculated polyp which prolapsed from the end colostomy five days after the operation.

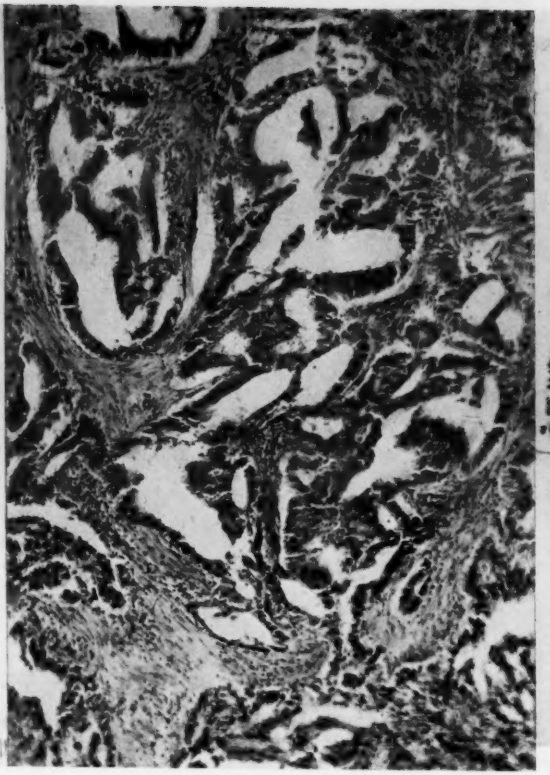

FIG. 2.—Histopathology of carcinoma shown in Fig. 1.

FIG. 3.—Histopathology of polyp shown in Fig. 1, showing pedicle of normal mucosa and adeno-papillomatous structure of the tumor. No evidence of invasion.

a frequent tumor in the rectum and colon of children from three to ten years of age, and has all the gross and histological appearance of the same tumor seen in adults, and yet instances of malignant degeneration of such tumors in childhood are unknown or at least extremely rare.

The occurrence, significance, and tendency to malignant degeneration of polyps of the large bowel has been discussed by Feyrter, a Vienna pathologist, and Westhues and Schmieden, clinical surgeons in the Schmieden Clinic in Frankfort.

Feyrter very carefully examined the colons of 1,800 persons coming to autopsy and found 1,017 polyps in 1,110 post-mortems. In persons over twenty years of age, he found: (1) No case of multiple polyposis and no case of papilloma. (2) Fifteen patients in whom carcinoma of the colon was the cause of death. (3) Four patients where latent carcinoma of the colon was found. (4) Three hundred fifty with polyps of the colon of which: six were carcinomatous and four were suspicious of carcinoma.

Feyrter found histologically no sharp line of division between hyperplasia and adenoma formation. He believes changes in the cell forms are difficult to interpret and may be either normal or pathological. Increase in the layers of epithelial cells, high cells, heavier staining of protoplasm with acid stains, smaller epithelium, indefinite boundary between the cells, are all difficult criteria to draw conclusions from. In one group of polyps there is little if any change in the epithelial covering of the polyps and in another there may be widespread changes of all of the epithelial cells, especially of the glandular area. However, there is a wide difference between a very small hyperplastic polyp with little change from the normal structure of the epithelium, to a hen's-egg sized growth with marked variation from normal epithelium. One is growing mucosa, the other is a growth, a tumor of the epithelium. Occasionally one sees a large flat based tumor which looks more kin to carcinoma than to adenoma or hyperplasia. Feyrter believes we must differentiate between (1) hyperplasia that remains as such; (2) hyperplasia that develops into an adenoma; (3) hyperplasia that develops into a cancer. He believes that in the great majority of glandular polyps it is not possible to predict their fate as to malignant degeneration. He believes and holds with Oberdorpher and Lubarsch that infiltrating destructive growth is the principal sign of cancer. The other signs of multiple layered epithelium, polymorphous nuclei branching tabules of epithelium give one only a feeling that malignancy may be present, but no proof. In Feyrter's study including the incidence of both hyperplasia and adenoma there were found, according to age, the following:

0–14 years out of 100 cases only 2 polyps
15–34 years out of 100 cases only 5 polyps
35–44 years 1/6 of the cases have polyps
45–54 years 1/3 of the cases have polyps
55–64 years 1/2 of the cases have polyps
65–74 years 2/3 of the cases have polyps
75–87 years 3/4 of the cases have polyps

If adenomas alone are considered:

	In Men	In Women
0–14 years 100 cases	No polyps	No polyps
15–34 years 100 cases	No polyps	1 polyp
35–44 years 100 cases	2 polyps	4 polyps
45–54 years 1/8 of the cases	Have polyps	1/10 have
55–64 years 1/4 of the cases	Have polyps	1/10 have
65–74 years 1/3 of the cases	Have polyps	1/8 have
75–87 years 1/3 of the cases	Have polyps	1/3 have

Of the 1,017 polyps of the colon from 1,800 autopsies

762 were millet-seed in size	75 %
175 were pea in size	17 %
35 were cherry-stone in size	3.5%
22 were hazel-nut in size	2.2%
5 were cherry in size	0.5%
4 were almond in size	0.4%
8 were bean in size	0.8%
7 were larger	0.7%

Westhues and Schmeiden believe that a differentiation must be made between polyps which are blastomatous tumors and those which are not. Their material has come from patients who have consulted a doctor because of symptoms or in whom polyps have been found in close relation to a carcinoma, Westhues believes the tendency to malignancy of polyps can be determined by the spacing of the cells, the relation of the nucleus to the membrana propria, the tendency to many layers of epithelial cells with dark nuclei, as well as the lack of order of the tubules and their tendency to have branching forms. He believes lack of differentiation with typical epithelium is important. Westhues believes that the respect of the muscularis mucosa is not an infallible sign of benignancy. He also believes that in 45 per cent. of carcinoma of the large bowel that small polyps are found in the neighborhood of the carcinoma and in all these growths ranging from a single polyp to diffuse polyposis of the colon that the tendency to malignancy exists.

Westhues classifies polyps of the colon into three groups:

(I) Innocent benign polyps, rare; mostly pedunculated, small and epithelium appears normal.

(II) Relatively benign polyps, rather rare; mostly solitary with short pedicle; may be plum- or apple-sized with connective-tissue pedicle. The periphery shows lack of differentiation of epithelium.

(III) Especially malignant polyps. These are flat and small, rarely over pea-sized. Relation of connective tissue to epithelium has no regular plan. Lack of differentiation of epithelium often found in neighborhood of carcinoma.

He believes most carcinomas of the rectum develop from such polyps.

It is extremely difficult to decide which of these conflicting views as expressed by Feyrter or Westhues is correct. The material I have examined (consisting of fifteen papillomata, more than twenty-five pedunculated polyps

in adults and more than fifteen polyps in children) would fall mostly in Class I or II of Westhues, where, using the histological criteria as to what constituted malignancy as laid down by Feyrter, only one polyp was malignant. In those polypoid tumors which were grossly malignant at the time of examination it remains difficult for me to say whether they were benign tumors which became malignant or whether they were malignant from the start.

In adopting a course of procedure in these single adenomas and papillomas, we must keep in mind what seem to me to be the outstanding and essential criteria of malignancy. Any gross evidence of ulceration, induration or invasion on the surface or base of the polyp must be considered evidence of malignancy and the tumor treated as a malignant tumor. This evidence may be obtained by vision through a proctoscope or by examination

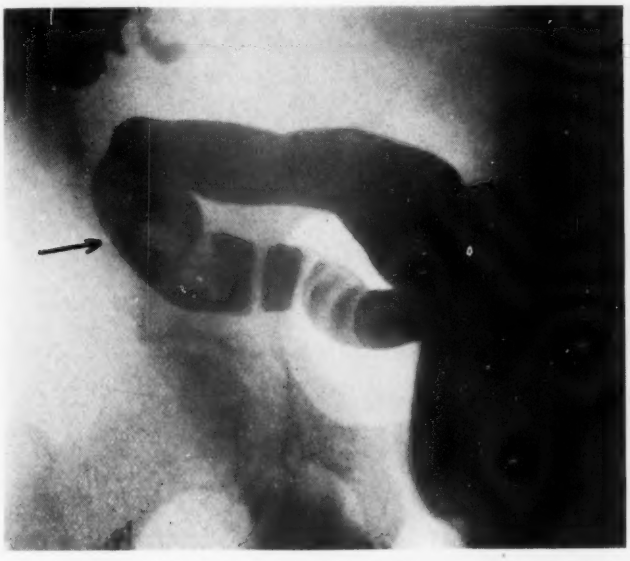

FIG. 4.—Air-bubble filling defect of polyp in the sigmoid. (Case of Dr. Donald P. Abbott and Dr. Dean Lewis.)

of the colon at the site of the tumor, by palpation of the tumor in the rectum or through the wall of the colon. Any induration, no matter how slight, must be regarded with the greatest suspicion and any puckering or indentation of the bowel wall at the base of the tumor must be considered evidence of invasion.

The histological examination of pieces of these adenomas or papillomas obtained by biopsy offers the same difficulties in diagnosis as similar tissue obtained by biopsy from the bladder or larynx. The change in the shape of the cells—mitotic figures in the nuclei of the cells; difference of staining properties of the nuclei—are all seen in what clinically are benign tumors and when removed and examined histologically are benign. The most important histological evidence that indicates malignancy is destructive invasion of the epithelium through the basement membrane and muscularis mucosa of the

bowel wall. This evidence can best be obtained and often can be obtained only where material for section is taken through the base of the tumor and this may be very difficult to get unless the whole tumor is removed. (Figs. 8 and 9.) It is unfair to ask a pathologist to pass judgment on the probable malignancy of one of these tumors unless he shares with the clinician the clinical history of development of the lesion, its gross appearance pathologically, and unless he has a piece of the tumor for examination through the base of the tumor. Mistakes can easily be made both ways. A papillary carcinoma of the rectum frequently has a large mass of papillary projections that may appear benign histologically and yet have a small area of induration in the centre of the tumor that is very malignant and invasive. Again a small

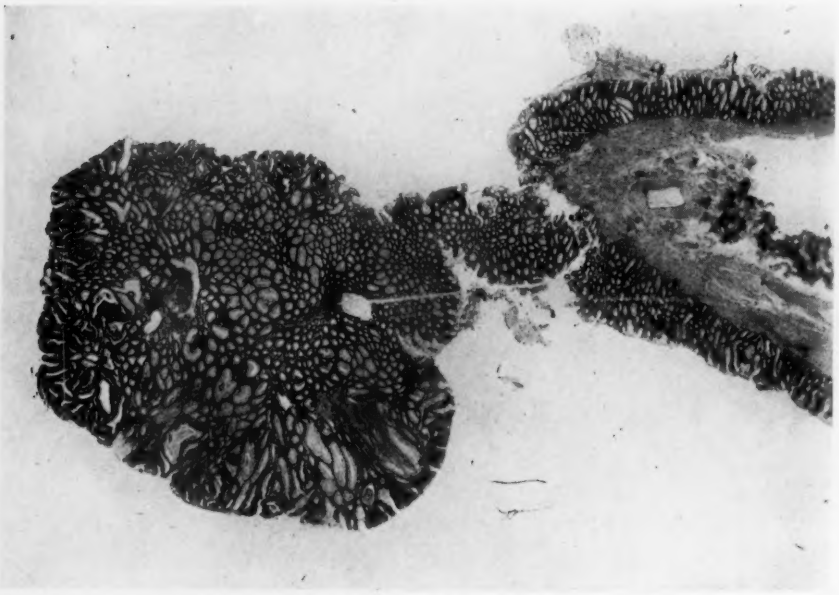

FIG. 5.—Histopathology of a bleeding polyp in descending colon which showed no filling defect in colon. Pedicle of normal mucosa. No evidence of invasion.

piece of the tumor may be given the pathologist who without knowledge of the gross appearance of the tumor might say it corresponded to histological sections of other tumors he had examined that had had metastases and consequently he declares it to be malignant. I have had several experiences of this kind where local removal of the whole tumor was subsequently done because clinically the tumor was benign and sections through its base after removal showed it to be benign. (Figs. 6 and 7.) In other words radical bowel resections could have been done if the pathological report on a small piece of the tumor had been accepted as final evidence. To emphasize this point again, the custom of sending small pieces of tumor tissue to a pathologist who shares no knowledge of the clinical or gross appearance of the tumor is unfair to every one concerned.

In considering the treatment of these polypoid tumors of the large bowel, each one must be regarded as a problem in itself.

Adenoma of the Rectum and Colon.—The pedunculated type of adenoma, the pedicle of which consists of normal mucosa stretched out by the tug of the tumor, occurs at all ages and in all portions of the colon. Early malignant degeneration of these tumors is rarely observed though they are frequently found in the colon, already the site of a well-developed carcinoma. (Four cases.) (Figs. 1, 2 and 3.) They bleed easily and occasionally copiously. In children they are a frequent if not the most frequent cause of bleeding from the large bowel. When in the rectum they may be palpated by the examining finger and if the pedicle is long enough may be prolapsed

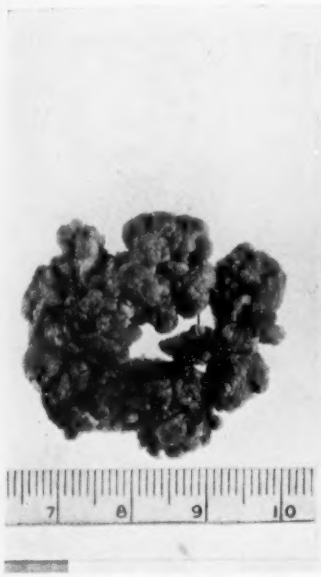

FIG. 6

FIG. 7

FIG. 6.—Papilloma removed from rectum which clinically appeared benign but biopsy had been made and section declared malignant. Local removal. Fig. 7 shows photomicrograph of section through the base of the tumor, which is benign.
FIG. 7.—Photomicrograph of section of tumor shown in Fig. 6. No evidence of invasion at point of attachment of tumor. Patient has been well without recurrence.

through the anus, in which event the pedicle may be ligated or clamped or cauterized and the whole tumor removed. Where they are higher in the rectum, the pedunculated adenoma may be seen through a proctoscope where the tumor may be examined for ulceration and mobility. It is usually possible to grasp the tumor by a long slender tenaculum so that it can be rotated to expose the pedicle which can then be fulgurated by an insulated applicator the size and length of a ureteral catheter. Here again the tumor can be completely removed. Occasionally when the adenoma is small or flat and without a pedicle the whole tumor is destroyed by fulguration. This procedure is not so desirable as it leaves the histological structure of the tumor in doubt. In any event, all of these patients should be re-examined after six weeks and the former site of the tumor inspected through the proctoscope.

Where the adenoma is beyond reach of the proctoscope its presence may be unsuspected unless the patient notices blood in the stool or it is found in the course of a stool examination. Where the adenoma is in the left half of the colon the blood is generally on the outside of the stool because of the solid character of the stool in this location. Conversely, when the bleeding tumor is in the transverse colon or right half of the colon the blood is inside the hard stool or intimately mixed with it. Obviously, the brighter the blood and the more fluid it is, the lower in the colon is the bleeding lesion. It must not be forgotten that the pedunculated adenoma occurs in the small bowel as well as the large and are occasionally cause of intussusception in the adult. The site of the adenoma in the large bowel above the rectum can be determined only by fluoroscopical examination of the colon. An air-bubble-like filling defect (Fig. 4) may be able to be pushed up and down the bowel

FIG. 8.—Papilloma at rectosigmoid. Resection of bowel. Photomicrograph through whole tumor at attachment to bowel wall. No evidence of invasion except possibly at A. Shown in high-power photomicrograph Fig. 9.

for a few inches, due to the pedunculated attachment of the tumor, and the filling defect is always present in the same place on repeated examinations. It should be emphasized that there is not a filling defect due to induration of the regular outline of the bowel wall but a filling defect resembling an air-bubble. In some cases it is impossible to find a filling defect and the diagnosis can be established only by exploratory laparotomy, after all other possible sources of the bleeding from the stomach and bowels have been ruled out as far as possible, it being recognized that bleeding from a carcinoma of the small bowel or Meckel's diverticulum is extremely difficult to diagnose. The following brief case report will serve as an illustration.

A male, aged fifty-three, who in times past had been treated medically for a definite duodenal ulcer, but had been free of ulcer symptoms for several years, noticed blood intermittently in the stool. The blood was fluid and sometimes red but often clotted. The blood was on the outside of the stools. Repeated proctoscopical examinations failed to reveal a source for the bleeding. Colon fluroscopy and films led one röntgenologist to diagnose multiple polyposis and arrows were placed on the films to indicate the polyps. Repeated fluoroscopicals and films failed to demonstrate the defects

in the same locations. Gross bleeding of relatively fresh blood continuing, an exploratory laparotomy was performed and a pedunculated adenoma about two centimetres in diameter with a long pedicle of normal mucosa was palpated on the sigmoid loop. With clamps on the colon above and below, the lesion of the bowel was opened along the longitudinal muscle band, the polyp delivered, the pedicle ligated, the tumor removed and the incision in the bowel closed by suture. (Fig. 5.) No other lesions were found.

This was a rather lucky "find" and where a repeated air-bubble filling defect is present the chances of finding the polyp are greatly improved.

Papilloma or Villus Tumor.—This soft, sponge-like, aborescent tumor is rather frequently found in the rectum and colon. (Fig. 6.) Fifteen cases have come to my service. These tumors are practically all sessile in attachment though certain parts of the tumor appear pedunculated. They vary in size from very delicate stalks to masses the size of an adult fist. They are

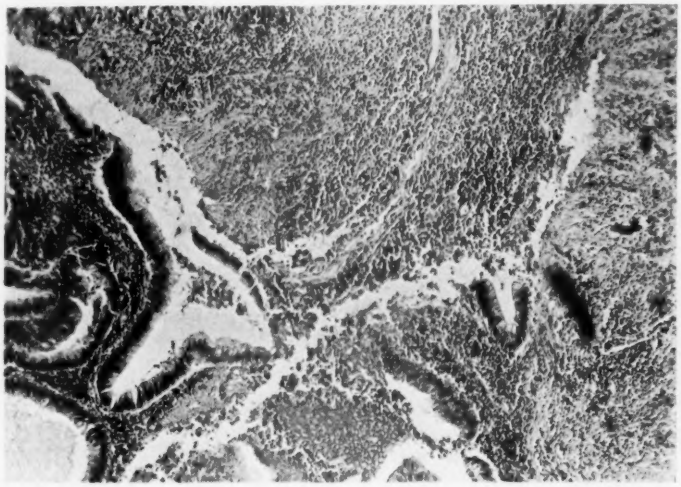

FIG. 9.—Photomicrograph of section at "A" in Fig. 8. Evidence of invasion of epithelium through muscularis mucosa. May be very early malignancy.

most commonly found in the rectum, but this may be because they are overlooked higher in the bowel. The papillomata bleed very easily and produce a large amount of mucus due to the increased surface of the bowel at the tumor site, as well as to the large number of goblet-cells found in their histological structure. These villus tumors occur in most part in adult life. As they tend to spread over a considerable surface of the bowel and to grow rather actively, the question of their malignancy and treatment offers many times a serious problem. It is in this group of patients that biopsy of the superficial portions of the tumor is unreliable either because malignancy is grossly present in some other part of the tumor or because definite evidence of microscopical invasion of the basement membrane could be found by examination of the base of the tumor.

The problem that usually rises is whether a radical extirpation of the bowel containing the tumor should be carried out, or where a purely local

removal is justifiable. When the tumor is in the rectum and can be palpated by the finger, the most important point to determine is whether induration is present in any part of the tumor. If it is present, it has been my custom to treat the tumor as if it were in effect a carcinoma, and do a bowel resection. If the tumor is soft throughout, a complete local removal of the tumor is indicated with subsequent examination of the histological sections taken through the whole tumor, including its base. This examination will determine the accuracy of ones judgment. (Fig. 8.)

In small high-lying papilloma fulguration will destroy the tumor but repeated examinations are necessary to be sure that no recurrence or evidence of malignancy develops. Wherever possible it is a better plan to completely remove the tumor. If it is low down, Allis forceps may surround the tumor and prolapse it through the anus where it is removed by cautery dissection going through the submucosa to the muscularis. The defect is closed over by approximating the edges of the mucosa with catgut stitches. Where the tumor is higher or larger we have, in these cases, split the rectum open posteriorly, after removal of the coccyx. The loose attachment of the mucosa

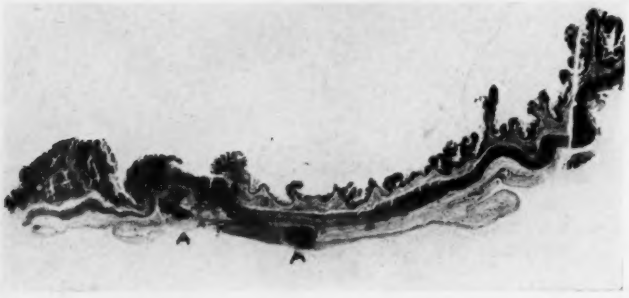

FIG. 10.—Giant section of colon with multiple polyposis, showing various types of polypoid tumors, and malignant invasion at "A". (Dr. Mark Loring's case.)

allows it to be prolapsed so that tumors lying at the level of the lower sacral concavity can be pulled down by grasping the healthy mucosa around the tumor with Allis forceps. After removal of the tumor by cautery and suturing the defect, the posterior incision in the bowel was sutured by a submucosal and muscular stitch and the bowel healed, a small fistula resulting in one patient. Where the papilloma in the rectum is so large that thorough removal would compromise the lumen of the bowel, the whole rectum should be removed. We have such case at present. Where the tumor is at the rectosigmoid or higher in the colon, a bowel resection is the treatment of choice. In the three cases of papilloma of the colon which I have operated upon, all had filling defects in the colon undistinguishable from carcinoma but the bowel wall at operation showed no induration or puckering and it was with difficulty that the tumor was palpated through the bowel wall in one case and in another at the splenic flexure it was impossible to palpate the tumor at all. In another patient where the tumor was in the descending colon,

obstruction had supervened and the œdema in the bowel wall made it very difficult to decide whether the lesions were benign or malignant. (Figs. 17 and 18.) On histological examination two tumors were benign throughout while in the other, one small area seen microscopically showed early breaking through the basement membrane by the tumor. (Figs. 8 and 9.)

Multiple Polyposis.—Where the colon is studded with polyps of all types —adenomas and papillomas, it is concurred in by all that preliminary ileos-

FIG. 11.—Filling defect at rectosigmoid from a polypoid tumor, shown in Fig. 12, which appeared benign through the proctoscope, but which was malignant when sections were taken through the base of the tumor. (Fig. 13.)

tomy followed by graded removal of the colon is advisable wherever the condition of the patient will permit it. Too often it happens that severe anæmia from single or multiple carcinomas of the colon or the physical condition of the patient precludes radical treatment. The large section made through the colon by Doctor Loring of such a case shows the various types of polyps. (Fig. 10.) In this patient three separate malignancies of the colon were present. Histologically, the examination of any single one of the adenomas or papillomas in this case would in no evident way differ from the histological structure of other adenomas and papilloma

which were benign and had remained so for varying lengths of time. What the factor is that hastens malignancy in one and fails to inaugurate it in many others is unknown, but to my mind is a most potent argument favoring prompt removal of all adenomas and papillomas of the colon wherever possible.

Inflammatory Polyps of the Colon.—In the course of a protracted ulceration of the colon from amœbic dysentery or ulcerative colitis, small islands of mucosa, between ulcers, hypertrophy and become fibrotic and have the

FIG. 12.—Gross appearance of polypoid tumor at rectosigmoid, which was malignant in sections taken through the base. (Fig. 13.)

gross appearance of adenomas. The polyps may reach the size of a walnut and give symptoms as bleeding and partial obstruction of the bowel. One such patient with a long-standing chronic ulcerative colitis has several large polyps of this type in the rectum and sigmoid that have been present for ten years without any evidence of malignant degeneration.

In another patient with ulcerative colitis a small polyp developed which was removed through the proctoscope and was pronounced malignant by the late Doctor Warthin. About a month after the removal of the polyp exami-

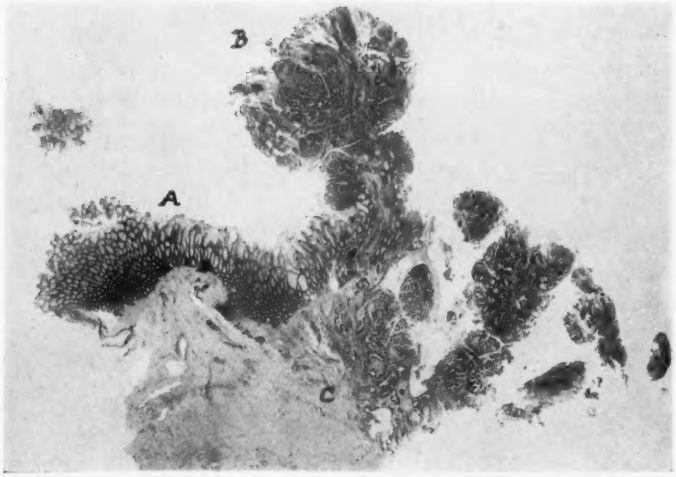

FIG. 13.—Polypoid tumor at rectosigmoid which shows normal epithelium at "A"; polypoid tumor of doubtful malignancy at "B", and invasion of bowel wall by definite malignant neoplasm at "C".

FIG. 14.—Filling defect in sigmoid loop caused by a tumor which had caused one gross bleeding of a pint of blood. Question of polyp or malignancy.

nation showed no evidence of polyp or tumor but in another six weeks a carcinoma had developed.

In some instances stalk-like papillomata and flat adenomata develop in the rectum which is the seat of a chronic inflammation. In one such patient a colostomy was done because of severe and uncontrollable bleeding from a group of such papillomata, which appeared benign on histological examination. After colostomy not only did the bleeding stop and the small tumors disappear from the rectum, but several flat raised adenoma-like structures appeared on the colostomy. One of these was removed for histological

FIG. 15

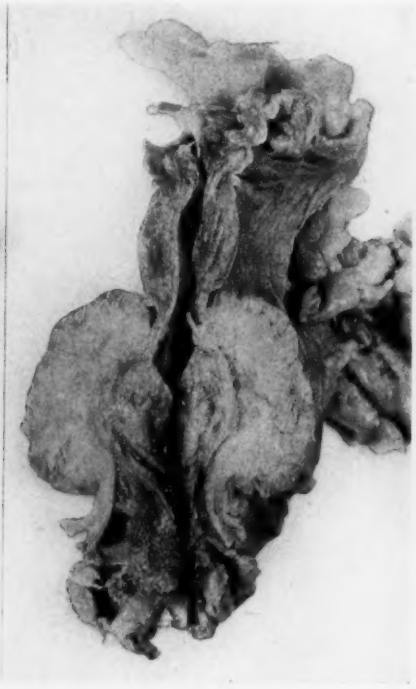

FIG. 16

FIG. 15.—Malignant polypoid tumor of sigmoid causing filling defect shown in Fig. 14.
FIG. 16.—Malignant polypoid tumor of sigmoid shown in Fig. 15, which has been cut through the bowel wall at the site of its attachment, showing gross evidence of infiltration of the muscularis of the bowel.

examination and showed elongated stubs of epithelium, increased height of the epithelial cells and chronic inflammation of the submucosa. Finally these structures disappeared from the colostomy. The patient having recovered from his anæmia insisted on having the colostomy closed, which was done. Shortly afterward the papillomata recurred and bleeding began again. The colostomy was reopened and the rectum was removed. No carcinoma was found, but extensive fibrosis and inflammation.

Fibiger has been able to produce papilloma-like tumors in experimental animals by feeding them the ova of cockroaches and there are other instances of parasites having been found in the base of polyps of the bowel. The meaning of this evidence is not entirely clear but indicates that inflammation

may produce lesions resembling in great detail structures which we call adenomas or papillomas and regard as tumor formation.

Carcinoma Grossly Resembling Large Flat Adenoma and Papilloma.—There exist occasionally in the rectum and more commonly in the colon lesions which are without clinical doubt carcinomas but which resemble grossly papillomas or large sessile adenomas (six cases). These lesions have palpable induration at the base of the tumor and in the colon almost always have some small area perhaps only a few centimetres in diameter which shows

FIG. 17 FIG. 18

FIG. 17.—Papilloma of descending colon, which caused obstruction of the bowel. A large mass of fæces became impacted above it, making it difficult to determine whether the tumor was benign or malignant.
FIG. 18.—Photomicrograph of tumor in Fig. 17, showing typical papillomatous character without invasion of the bowel wall.

puckering of the bowel wall. It is at this point that invasion of the muscularis of the bowel is taking place. If visible by proctoscope, these tumors may look benign, though usually superficially ulcerated, but if they are too high to palpate, laparotomy should always be carried out so that actual inspection and palpation of the bowel can be done. (Figs. 11, 12 and 13.)

In the X-ray examination of the colon, most of the defect may appear to be in the lumen of the bowel, but often a small permanent defect in the bowel wall will be seen. (Figs. 14, 15 and 16.) In the rectum where a large

papilloma may be present which to touch, inspection, or biopsy may be benign in most part, one small area may be felt to be indurated. This is an almost infallible evidence of malignancy and a biopsy through this area will reveal the true nature of the tumor.

Whether this group of tumors so closely resembling benign tumors are examples of malignant degeneration of benign tumors or are tumors which were malignant from the beginning is very difficult to say. The difficulty is clinical in that very few of these clinically benign tumors have been observed for any length of time and have been observed to become malignant. The difficulty is also pathological for it is well known that malignant tumors, especially papilloma of the bladder and larynx, have benign-appearing areas which mask a tumor, apparently malignant from the start. Suffice it to say that all of the polypoid bleeding tumors of the rectum and colon must be regarded with suspicion as to their tendency to or actual state of malignancy even though we know that many of these tumors are benign and stay so for long periods of time.

SUMMARY.—(1) Though adenomata and papillomata of the colon and rectum may be benign by all clinical and histological criteria, this can be determined only by histological examination of the attachment of the tumor to the bowel wall.

(2) Complete removal of all polypoid tumors of the large bowel is indicated.

(3) The slightest evidence of ulceration or induration in these tumors is highly significant of malignancy and radical removal of the bowel is indicated.

(4) Examination of biopsy material is unreliable unless material is obtained from the base of the tumor. It is highly advisable to have the entire tumor for examination where it appears benign.

TUMORS OF THE SMALL INTESTINE

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Tumors of the small intestine have always been considered a rare condition. Recently, however, there have been many reports citing rather large series of cases. This, coupled with the fact that the clinical syndrome caused by them is vague and the individual symptoms are often seen and no adequate cause ascribed to them, makes a review of these cases especially applicable at this time. This is one condition where the treatment is ahead of the diagnosis. Relatively few of the tumors are diagnosed before operation or autopsy and the majority of them are opened up on suspicion of some other condition. In this paper a brief review of some of the articles on small intestinal tumors will be made and several new cases added.

Raiford,[1] in an admirable article which was published two years ago, reviews a series of eighty-eight small intestinal tumors of all types, finds the incidence of malignancy among them to be 43 per cent. Many others have reported that from 3 to 6 per cent. of all malignancy of the gastro-intestinal tract occurs in the small bowel. Carcinoma of the small bowel is usually of annular type with a tendency to constriction, readily adherent to adjacent structures, or malignant degeneration of a papilloma; such a growth is often quite massive, yet causes no obstruction of the small bowel. The benign growths are usually intraluminary, freely movable, non-adherent externally, with a tendency to intussusception.

There has been much discussion of the question of carcinoma of the duodenum. It is generally recognized that the majority of small intestinal carcinomata occur there. As a rule these may be divided into three types, based on their point of origin, namely, the pre-ampullary, the ampullary and the pre-jejunal. All observers agree that the greatest number of growths occur in or about the ampulla of Vater. In fact there are some who maintain that if these were excluded, carcinoma of the duodenum would be a nonentity. It is also reported as quite possible that malignant lesions occurring in the pylorus may often extend through into the duodenum and give rise to doubt as to their actual origin. There have been many reports as to the incidence of carcinoma arising on the basis of an old duodenal ulcer. As yet this has not been proved a possibility worthy of clinical recognition.

The jejunum holds second place in frequency of occurrence of carcinoma. The cases at The Mayo Clinic up to 1929[2] show twenty-one out of a total of fifty-five carcinomas of the small bowel were in this region. This is to be compared with four out of sixteen as found by Raiford.[1]

The ileum shows the lowest incidence of carcinoma and the highest incidence of tumors of the lymphoblastoma group. This latter type is reported

with only the greatest rarity in any but the region of the lower ileum, a fact which probably is related to the anatomical increase of lymphoid tissue in that locality. It has been stated by two observers that the incidence of the lymphoblastomas in the ileum make up about 62 per cent. of the total of this type in both the large and small intestine. These tumors form a class about which little is known pathologically. Many so-called lymphoblastomas eventually turn out to be on a chronic inflammatory basis. Suffice to say that most of them occur in the lower ileum and in every way clinically resemble carcinoma or some of the benign tumors. The true lymphoblastomata or sarcomata are extremely malignant.

By far the majority of the benign tumors consist of adenomata, although several writers have found fibromata and myomata the more frequent. Adenomas may occur any place in the small intestine but show their greatest frequency in the ileum, next in the duodenum, and last in the jejunum. Raiford[7] reports figures for this type as ten, four and one, respectively, in his series. These adenomata may vary from the size of a pea to the size of a walnut and are quite prone to undergo malignant change. Seldom do they get as large as the one to be reported in this paper without marked obstruction and consequent removal. Many writers have included under adenomas the small intestinal multiple polyps which are so often found in the large bowel. These cases of polyposis are not confined to the large bowel. In fact, Saint[3] states that about one-fourth of all polyposis occurs in the small bowel. The origin of the polyps has caused a good deal of confusion, as some claim that those occurring in the small gut are merely hyperplastic glands. But for all practical purposes they also may be considered adenomata. Of all the benign tumors to be found in this region they are probably the most prone to become malignant and for this reason comprise the most important group in clinical recognition and treatment.

In the cases to be reported in this paper two of this series were suspected of polyposis (Case I, B. G.; and Case III, S. V.). The former had several suspicious-looking areas resembling polyps in the large bowel on his first barium enema. These were not found later. The X-rays in Case III showed a polyposis of the duodenum which was not verified at operation.

Other types of benign tumors are, of course, found, but their symptomatology is in no way different from small bowel tumors in general. They are not prone to undergo malignancy. Their importance lies, therefore, solely in the mechanical symptoms produced. Clinically, tumors of the small intestine present a hard and knotty diagnostic problem. The history is often identical with that given for chronic gall-bladder disease or peptic ulcer. At other times when local symptoms are lacking, it has been confused with even primary anæmias.

The symptoms of tumors of the small intestine are for the most part due to the obstruction which the tumor causes. This obstruction is usually a partial intermittent affair. Only rarely when an acute catastrophe, such as an intussusception, has taken place, are the symptoms of a total obstruction

present. Obstructive symptoms often simulate the type seen in the old scarred duodenal ulcers which have given rise to a pyloric stenosis. Tumors of the duodenum, especially the pre-ampullary portion, give the above picture. If the tumor is below the ampulla of Vater, the vomiting may be quite characteristic, that is, copious, bile-stained, and with many undigested food particles, and low or absent hydrochloric acid. Such a picture should suggest obstruction, in the third portion of the duodenum. Obstruction is usually intermittent, the doctor often seeing the patient between attacks when no physical signs in confirmation can be elicited.

Intussusception is a complication of about 30 per cent. of small intestinal tumors. It is more frequent by far with the benign tumors than with the malignant, but its presence should not cause the tumor to be classified as benign.

Hæmorrhage, either gross or microscopical, is another important sign. It is often not noted by the patient, but in most of the benign tumors and practically 100 per cent. of the malignant tumors occult blood may be found in the stool. Two of the cases to be reported here are examples of a small intestinal growth whose first symptom was a profound gross hæmorrhage. It is wise to keep in mind the possibility of small intestinal new growths in any case of gastro-intestinal bleeding. It is possible that they may account for many of the otherwise unexplained gastro-intestinal hæmorrhages.

Pain is a symptom due for the most part to the obstruction present. It varies with the locality of the tumor but is most often manifest in the epigastrium or about the umbilicus. It may be either intermittent or constant, but is usually of the griping character which is seen in intestinal obstruction. The pain of the intussusception is, of course, severe and intense, with sudden onset, and, if spontaneously reduced, of sudden cessation.

Often duodenal tumors give a cyclic story suggestive of ulcer with obstruction. The differentiation of the conditions lies with the X-ray and, to a lesser degree, the measurements of the gastric acidity, which is often low.

Symptoms secondary to the small intestinal neoplasms usually occur in the malignant type. Here cachexia, loss of weight, anæmia, *etc.*, may be the cardinal points in the history. When these are manifest the disease has usually gone beyond the operable stage and any surgical intervention is purely a palliative measure.

The presence of a mass, palpable, at any time, is probably the most important physical sign to be looked for. This may not be constant, as in an intermittent intussusception, or may be present and constantly increasing in size, as in the malignant tumors. The early malignant and the benign small gut tumors, when palpable, have one important characteristic, their mobility. A tumor that seems to slip from the fingers, and is freely movable is almost sure to be in the ileum or jejunum if in the intestinal tract at all. All other gastro-intestinal structures are comparatively fixed. Malignant tumors of the small gut, however, once they have eroded through the wall of the gut, become fixed to surrounding structures (Case V) and relatively immovable.

The X-ray is, of course, the greatest single aid we have in the pre-operative diagnosis of these lesions. Evidence of obstruction below the pylorus and above the ileocæcal valve is gained by seeing the distended loops of gut with their typical step-ladder arrangement, together with the intestinal markings (valvular conniventes) outlined by barium (especially in the jejunum). Occasionally, too, a flat plate of the abdomen may reveal coils of small intestine distended by gas which is not palpable, or an opaque mass. This is not evidence in itself of a small intestinal tumor. To locate by X-ray a partial obstruction or tumor in the small intestine below the duodenum and above the extreme lower portion of the ileum is almost no better than a guess, unless you can demonstrate a narrow band of barium by the obstruction. A modification of the ordinary technic of doing the gastro-intestinal series in cases where small intestinal pathology is suspected has proved of value. Plates are taken before the barium meal, then after the meal fluoroscopical observations are made at intervals of not greater than one hour until the meal has passed into the cæcum, because a twenty-four-hour plate taken to check up on any extreme retention may show ileal regurgitation, as pointed out by Case. In this manner a very general idea can be had of the point of arrest of the barium, if any. Illustrative of the above points the following cases are reported:

Case I.—B. G., a nineteen-year-old cigar store clerk, came to the clinic complaining of weakness, loss of weight, and fatigue. Symptoms had been present for only three weeks. During this time he had also noticed black tarry stools. Previous to this time he had no gastro-intestinal pain, gas or belching. He was never nauseated and he had no vomiting. X-rays showed nothing. The above type of story is not infrequent. The cases are usually X-rayed, nothing found, and the usual measures carried out, rest, Sippy diet, *etc.*, on the supposition that this is either a so-called acute ulcer, duodenitis, or an old duodenal ulcer that is not demonstrable by X-ray.

A physical examination showed some tenderness about the umbilicus but no masses were felt. His blood count showed 2,670,000 red cells with a hæmoglobin of 37 per cent. Bed rest with the usual régime, as outlined above, was instituted, but the bleeding continued. One month after his admission an exploratory operation was advised. On opening the abdomen all organs were found in good condition, except that a Meckel's diverticulum with a small ulcerated mass in it was found. The mass was about 1.5 centimetres in diameter. Resection of this area and about seven centimetres of the small intestine was done and an end-to-end anastomosis performed. Patient made a good recovery. Pathological sections showed a rapidly growing leiomyoma with no evidence of malignancy. In this case there were no signs prior to the operation that would positively identify small intestinal pathology.

Case II.—(Courtesy of one of the staff of St. Vincent's Hospital.) Mrs. S. H. was a twenty-nine-year-old woman who gave a story of attacks of para-umbilical griping pain accompanied by nausea and vomiting and lasting three to five days. Four years before she had had jaundice following the birth of her child, but there was no pain or vomiting at that time. The attacks of which she complained in her present illness had been getting more and more frequent and now came one week apart. She had no jaundice. Two years before she had been operated upon and told she had stomach ulcers. There was no relief.

Her physical examination was essentially negative save for the presence of tenderness just to the right of the umbilicus and a soft rolling sausage-like mass in the right

lower quadrant. Exploratory operation was performed. A thick-walled gall-bladder was found and removed. The rest of the exploration was negative. Eleven days after operation she began to vomit and had slight abdominal pain. This was unrelieved; the next day she was again opened. An intussusception of the lower ileum was found. This was relieved. No tumor could be felt. One week following this the intussusception returned. Operation this time disclosed the same findings as before plus a small thumb-sized pedunculated tumor. This was removed. Patient then made an uneventful recovery. Pathological report showed a benign papillary adenoma.

This is a case which was operated upon three times before the true diagnosis was found. The tumor was small yet gave rise to symptoms that were confused with a

FIG. 1.—Benign tumor jejunum showing dilated duodenum outlined by arrows. (Case III.)

duodenal ulcer and gall-bladder disease. The presence of the mass in the right lower quadrant and para-umbilical region should have given rise to suspicion of small intestinal pathology.

CASE III.—S. V. This case is similar to Case II. The patient was a seventeen-year-old farmhand who had had attacks of pain, nausea and vomiting for six years. For the past two years the pain had been in the lower mid-abdomen and was often sharp and stabbing in character. For the last few months he had vomited almost daily. He had never had any sign of bleeding. Two years ago he had his appendix removed for the present complaint. There was no relief. X-rays showed a dilated small intestine with polypoid defects in the duodenum and upper jejunum.

Operation was undertaken with the diagnosis of probable small intestinal tumor. On

opening the abdomen the greater portion of the small bowel was greatly distended and thickened, due to a band attached to the anterior abdominal wall above and to the right of the umbilicus, which extended down into the pelvis to the left. While removing this band it was noticed that the small bowel intussuscepted and on exploring this a tumor about the size of a turkey egg was found, about fourteen inches below the ligament of Treitz. (Fig. 7.) This was slightly pedunculated. The upper small bowel was enormously distended, which gave the polypoid defect in the X-ray examination. (Fig. 1.) Resection of six inches of gut with an end-to-end anastomosis was done. The other organs showed no demonstrable pathology. The tumor proved to be a papillary adenoma of the jejunum, benign. Recovery was uneventful.

This case is one with a history that should cause suspicion of a small bowel tumor. The X-ray was still indefinite. It is interesting to note that his appendix had been removed as the cause of the trouble.

Case IV.—Miss K. D., a woman of forty-nine, was first seen in 1929, at which time

Fig. 2.—Showing the retained barium in the small bowel. (Case IV.)

Fig. 3.—Showing the retained barium in the small bowel. (Case IV.)

she passed a large amount of dark clotted blood by rectum and then fainted. She had no pain or gastro-intestinal distress either in the past or at this time. The hæmoglobin was 20 per cent.; red blood-cells, 1,330,000; white blood-cells, 16,200. Under treatment with transfusions and iron, the blood showed 65 per cent. hæmoglobin two months later. A complete study of the gastro-intestinal tract at this time revealed no pathology.

One year later she reported the onset of severe, profuse menstruation. The hæmoglobin at this time was 60 per cent. and multiple fibroids were found in the uterus. A hysterectomy was done and two months later the hæmoglobin was 78 per cent. She remained well and asymptomatic until May, 1933, when bleeding hæmorrhoids were noticed. At this time the blood was all bright red and there was no clinical evidence of upper gastro-intestinal bleeding. Resection of the fissure and a clamp and cautery operation was followed by a rise in the hæmoglobin from 45 per cent. to ninety-four per cent. in less than three months.

In May, 1934, she suddenly began to feel weak and faint, and soon afterward passed some dark fæces, indicative of upper intestinal hæmorrhage. There was no pain, nausea

or vomiting. The hæmoglobin fell to 27 per cent. but rose to 66 per cent. after three transfusions in two weeks. X-ray studies at this time showed a normal stomach and colon. While films of the latter were being taken twenty-four hours after the barium by mouth had been given, several opaque shadows were noted apparently in the small intestine. (Figs. 2 and 3.) These were followed at intervals for the eight subsequent days. They retained their original size and shape but would often separate into two separate shadows which were movable. They remained, however, in the left upper quadrant. A diagnosis of small intestinal polyp or diverticulum was made and an exploration undertaken. At operation there was found a mass about the size of a hen's egg about eight inches below the ligament of Treitz. The contiguous jejunum was slightly dilated but there was no apparent obstruction. The mass extended both inside and outside the lumen of the gut but was not adherent to the surrounding structures. The dilated loop of small intestine was resected with the tumor *in situ* (Fig. 4), and an end-to-end anastomosis done. To date (two weeks) the patient has made an uneventful recovery. The patho-

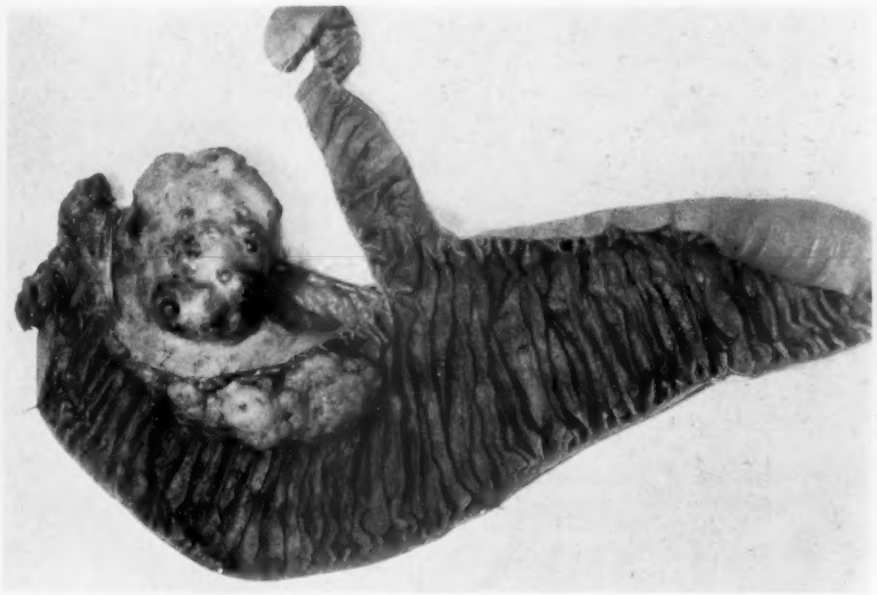

FIG. 4.—Leiomyoma of the jejunum. (Case IV.)

logical diagnosis was, large intramural and polypoid leiomyoma of the jejunum with ulceration of the mucosa.

The next five cases show malignant growths.

CASE V.—B. E. S., a thirty-six-year-old woman, complained of weakness, loss of weight, and constant lower abdominal pain. For ten to fifteen years she had had constipation, heartburn and gas. Appendix out thirteen years ago. Seven years ago left tube and ovary removed. This was followed by an ectopic pregnancy on the other side, which necessitated another operation. Five years ago she had adhesions cleaned out. Just previous to her present admission she had gas and discomfort p.c. relieved by food and soda. One month ago she suddenly vomited a large quantity of blood and had several tarry stools. Since then she has been losing weight, getting progressively weaker and vomiting almost daily. Physical examination showed a marked epigastric tenderness, distention and reversed peristalsis. X-ray showed a dilated small intestine. It was thought that this was probably due to adhesive bands partially constricting the gut. At operation the

abdomen was found full of old adhesions, and after separation of many of these, a mass the size of an apple was seen at about the junction of the jejunum and ileum. This was hard, nodular, fixed to the posterior abdominal wall and adherent to several other loops of small intestine. A biopsy was taken which showed an adenocarcinoma. A palliative enteroenterostomy around the mass was done. Post-operative course was uneventful. When last heard from one month later, she was having a great deal of difficulty with constipation.

It is interesting to speculate here as to whether she had a preëxisting

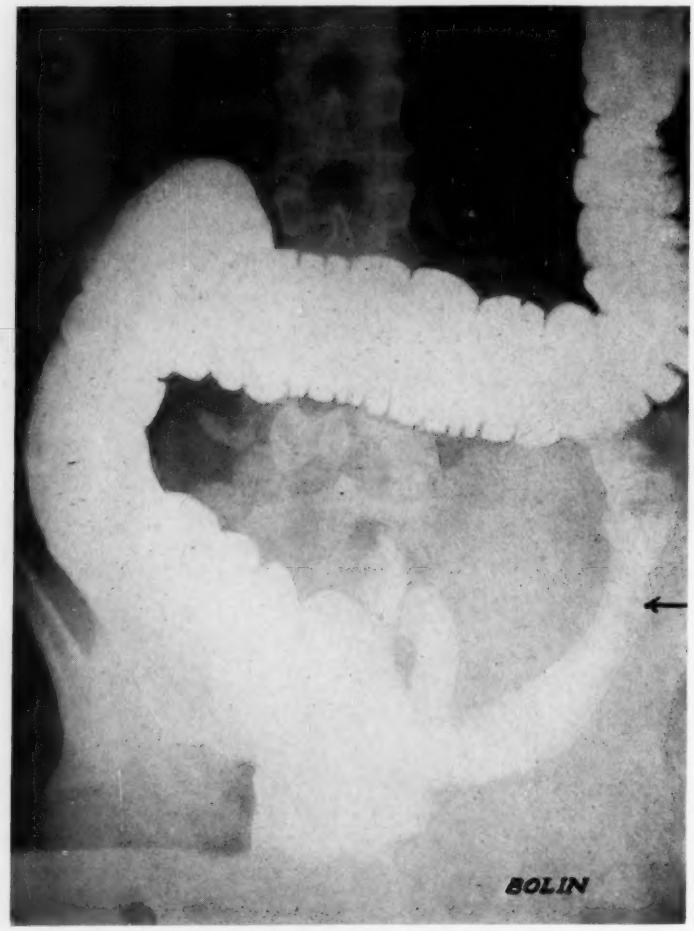

FIG. 5.—Carcinoma proximal ileum adherent to colon. (Case VI.)

adenoma which was causing her trouble before and which, not recognized, had since become malignant.

CASE VI was a fifty-year-old accountant who had noted a movable lump in the lower abdomen for about one year. He had been bothered a good deal in late years by constipation alternating with periods of regularity. Twelve days before admission he felt as though he had a fever. He was markedly constipated but was relieved by a dose of castor oil. Eight days before admission he again noted the lump in the lower left abdomen. He was seen by a local physician who made a diagnosis of diverticulitis

of the sigmoid. Barium enema in our office showed a constant defect at the junction of the descending colon and sigmoid. (Fig. 5.) The mucosal markings were evident and the lesion appeared to be non-malignant. On opening the abdomen a mass the size of a grapefruit, which was adherent to both the sigmoid and the small intestine, was found. This was resected and adherent pieces of both large and small bowel were removed. A Rankin modification of a Mikulicz resection of the large bowel was done and the ends of the small intestine were turned in and a side-to-side anastomosis was performed. One month later the Mikulicz drainage was closed. Patient made an excellent recovery. Histological sections showed a highly malignant carcinoma of the small intestine. Recent report, thirty months after operation, states the patient is in good health, and attending to business.

CASE VII.—Male, illiterate Filipino, aged twenty-five. Complaining of vomiting and abdominal pain. Indefinite history of gastro-intestinal distress past year. Vomiting and abdominal pain shortly after eating for the past month. Loss of weight and strength.

FIG. 6.—Carcinoma proximal jejunum; direct extension to fourth part of duodenum. (Case VII.)

FIG. 7.—Adenoma of jejunum.

Kolmer and Kahn were negative. Hæmoglobin, 98 per cent. X-ray of the chest showed active tuberculosis of both lungs in the infraclavicular region. X-ray of the gastro-intestinal (Fig. 6) tract showed stomach and duodenum large, narrow and partially obstructed area about region of the duodenal-jejunal junction, with dilated coils of small bowel beyond this area of multiple constriction. *Diagnosis.*—Small bowel obstruction: (1) tuberculosis; (2) new growth; (3) hernia of small gut into lesser peritoneal cavity.

Exploration revealed a large tumor, six by eight centimetres, metastatic, lying retroperitoneally behind the third portion of the duodenum with an annular carcinoma in the wall of the jejunum about ten centimetres beyond the ligament of Treitz. A posterior gastroenterostomy was done with relief of all symptoms. Patient discharged in fifteen days.

CASE VIII.—Male, aged fifty-seven, cook. Complaints, weakness, vomiting and loss of weight and strength. Vague abdominal pain for one year. Attributed vomiting to a

prolonged alcoholic spree. Examination was negative except abdomen, which gave a feeling of resistance in the epigastrium. No tumor palpable. X-ray showed the stomach and bulb to be dilated, otherwise negative; (Fig. 8) dilatation of duodenum and almost complete obstruction at the ligament of Treitz. At operation multiple nodules were found throughout the omentum and parietal peritoneum with a tumor lying retroperitoneally at the duodenal-jejunal angle, involving the bowel wall, inoperable. A posterior gastroenterostomy was performed.

Patient's condition was uneventful until the tenth day when with sudden delirium he expired. Autopsy limited to the abdomen confirmed the diagnosis of a primary adenocarcinoma of the third portion of the duodenum with abdominal metastasis, possible metastatic cerebral carcinoma.

Case IX.—Male, sixty-seven years. Complaint, weakness, pain in abdomen, swelling of legs. Dated trouble back about three months, with generalized pain throughout whole abdomen. Pains were colicky and sharp, with distention and gurgling in abdomen. With these attacks had nausea and vomiting. About this time complained of constipation.

Fig. 8.—Carcinoma proximal jejunum at duodenaljejunal flexure. (Case VIII.)

Fig. 9.—Carcinoma terminal ileum. (Case IX.)

Attacks were always precipitated by the taking of food or liquid. Went on starvation diet for days at a time, then noticed swelling of legs and great weakness.

Examination of abdomen showed it to be slightly distended; no masses, no tenderness. Blood in stool on three occasions. Hæmoglobin, 65 per cent. X-ray (plain plate) of abdomen showed dilated small bowel. Barium enema showed colon to be negative. No ileal regurgitation. *Diagnosis.*—(1) Neoplasm of small bowel in ileum; (2) adhesions from old appendix. (Fig. 9.) Operation was advised and refused. Patient lived two months and autopsy revealed primary carcinoma of the ileocæcal junction; terminal bronchopneumonia.

Comment.—The nine cases reported in this paper are interesting from several angles. The solitary adenoma of the jejunum in Case III is one of the rarest of the benign tumors in this region. This adenoma had reached a comparatively enormous size before removed. These usually produce complete obstruction long before they attain this size. This is illustrated in Case II, where a small thumb-sized tumor produced a surgical emergency that would probably have been fatal if not corrected. Case I is interesting from the standpoint of absence of local signs or symptoms.

Attention is called to the widely varying histories and the frequency with

which the true diagnosis is missed. In only two of the benign cases was a pre-operative diagnosis made. The presence of unexplained gastro-intestinal bleeding, intermittent obstruction or a story not typical of any other common abdominal condition should draw attention to the possibility of a tumor of the small intestine.

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FREE OMENTAL GRAFTS IN ABDOMINAL OPERATIONS

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Omentum resists infection, encapsulates infection, prevents adhesions and acts as a hæmostatic agent. Senn,[1] in 1888, first advocated the use of the free omental graft and found that it became firmly adherent and vascularized. He also demonstrated that the firmness of the adhesion was increased by scarification. Later observers concluded that detached omentum becomes necrotic, but Brocq, Ducastaing and Reilly[2] established the fact that the free omental graft survives while preserving its specific character—and that, histologically, there is a remarkable persistence of the endothelium.

Union is complete in three days, new capillaries have formed in four days and the grafts are almost completely absorbed in four months, leaving the surface endothelium.[3, 4] Peet and Finton[5] and Davis[6] believe that free transplantation of the omentum is not successful when infection is present. The writer questions this conclusion. (See Case V.) Free omental grafts may be used to cover peritoneal defects anywhere in the abdomen. They have been used to cover perforated ulcers and gunshot wounds of the stomach and intestines; to cover suture lines in the stomach, intestines or bladder; to peritonealize the pelvis or the cervical stump after hysterectomy; the duodenal stump; the raw area left after releasing adhesions around the terminal ileum and to cover the stomach and duodenum after the release of gall-bladder adhesions. Chislett[7] advises their use in strangulated hernia where the bowel wall is denuded or lacks lustre to prevent possible perforation or probable adhesions. Loewy,[8] in 1900, was the first to describe the hæmostatic action of the omentum. It has been used in wounds of the liver, spleen and kidneys for this purpose.

The technic of transplantation is important. Use the thinnest and most vascular area of omentum available. The graft should extend beyond the raw area to be covered. If possible, the edges should be turned under. Very fine catgut sutures should be used and placed close together around the circumference of the graft. The raw edge of the great omentum should be turned under and sutured and should not be left in a thick mass to form undesirable adhesions. Fatalities have resulted from omission of this precaution. Success in the use of omental grafts is more likely to follow sharp dissection, a clean field, absolute hæmostasis, prompt transfer and accurate suture of the graft to its new location. Resection of the entire omentum must be avoided for gastro-intestinal hæmorrhages occur in 4 per cent. of all cases of total resection of the large omentum with a fatality of 50 to 60 per cent., according to Karger, of Biers' clinic.

Conclusions.—Our own experience leads us to believe: (1) Free omental

grafts will live, become adherent to the underlying attached structure, prevent adhesions to surrounding organs and, at times, even remain free from surface adhesions in the presence of pus. (2) They are hæmostatic. (3) They aid in preserving peristalsis by the prevention of crippling and immobilizing adhesions. (4) They strengthen weak suture lines and resist infection.

CASE I.—*Pyloric and Duodenal Graft.*—E. S., a single female, aged fifty-two, was admitted to the Methodist Hospital January 20, 1927. Had a cholecystotomy and curettement seven years ago. Four months ago, was operated upon for a perforation of the common duct the size of a lead pencil. Bile gushed forth as the peritoneum was opened.

FIG. 1.—Dense adhesions hold the pylorus and duodenum against the gall-bladder, causing pyloric obstruction.

The common duct was five times normal size and filled with stones. The gall-bladder could not be found. T-tube drainage was instituted. She had considerable indigestion following this. When readmitted, she had been ill two days with great epigastric pain and continuous vomiting, had an ashen gray color and was jaundiced.

Diagnosis.—Acute pancreatitis. Operation showed massive adhesions necessitating knife dissection. Fat necrosis was present. The gall-bladder was found and removed, the common duct was emptied of many small calculi and a T-tube inserted. There was a raw area on the pylorus and duodenum two inches by three inches in size completely denuded of peritoneum. A free omental graft was carefully sutured over this. In November, 1933, she looks and feels well and has gained in weight. Has slight indigestion at times. (Figs. 1, 2 and 3.)

FIG. 2.—The pylorus and duodenum have been dissected free, leaving a large raw area without peritoneum.

FIG. 3.—The raw area on the pylorus and duodenum has been covered by a free omental graft, carefully sutured in place.

CASE II.—*Pyloric and Duodenal Graft.*—M. A., Female, aged thirty-two, admitted to the Methodist Hospital October 23, 1928. Fifteen months ago, had a cholecystectomy with drainage for chronic catarrhal cholecystitis. She was well for a year and then suffered from epigastric pain and vomiting immediately after meals. For one month prior to admission, pain has been constant and patient has been able to eat very little. Has lost thirty pounds in the past year. Operation by Dr. Seymour Clark. The pylorus and duodenum were adherent to the liver in the region of the gall-bladder fossa. After separation a considerable raw area was left on the pylorus and duodenum. This was covered by a free omental graft. In November, 1933, had gained thirty pounds in weight and was free from gastric symptoms.

CASE III.—*Graft over Jejunal Suture Line.*—Autopsy, intact graft. J. S., male, aged 49, eight months ago, had a jejunostomy performed at another hospital. Two adjacent loops of jejunum had been sutured together. His symptoms still persisted, so a posterior gastroenterostomy was performed. In an effort to secure sufficient jejunum near the previous jejunostomy, a small opening was torn in the previous jejunal scar. This was sutured and a one and a half by one inch omental graft tacked over it. He died of a pulmonary complication. Autopsy showed the graft to be living and there was no leakage from the suture line.

CASE IV.—*Graft in Gall-bladder Fossa.*—Autopsy, intact graft. E. C., female, aged thirty-three years, was admitted to the Methodist Hospital April 21, 1931. A cholecystectomy and an appendectomy were performed May 1, 1931. After removal of the gall-bladder, an attempt was made to suture the liver bed. This was friable and the sutures cut through so finally an omental graft was placed in the gall-bladder fossa and loosely tied in place. A violent pneumonia commenced the day of operation and death ensued on the third day after operation. Autopsy showed no peritonitis. The omental graft was living and healing in well.

CASE V.—*Graft Over Leaking Ureter in a Pelvic Abscess.*—Reoperation, no adhesions. E. J., female, aged fifty-eight years, was admitted to the Methodist Hospital March 13, 1931, suffering from pelvic distress. A hysterectomy was performed, removing both tubes and ovaries. There were many pelvic adhesions. A pelvic abscess slowly developed and one month later, a second operation was performed. Deep down in the pelvis was an abscess covered by many loops of adherent intestines. After separation of the adhesions and evacuation of the pus, a tiny pinpoint opening was seen in the dilated right ureter, well down in the pelvis. This was covered by a free omental graft which was held in place by gauze packing. A second graft was sutured over a raw area on the small intestine. The remainder of the lower end of the great omentum was then drawn into the pelvis and the pelvis packed full of gauze. Convalescence was stormy. There was profuse purulent discharge somewhat suspicious of a little urinary leakage for several days. Recovery finally ensued.

Two years later, February 6, 1933, a third operation was performed for the repair of a ventral hernia. Strange to relate, there were few adhesions in the pelvis and the region of the omental graft on the right ureter could be easily found. There were no adhesions. The surface of the graft was covered with normal peritoneum. There was a roughness and pebbly appearance much like the Scotch grain leather used in winter shoes. There was no doubt at all that the graft had lived in the presence of infection.

CASE VI.—*Graft Covering Peritoneal Defect in Abdominal Wall.*—E. Y., female, aged thirty years. Appendectomy in 1921. Bilateral salpingectomy in 1924. Removal of intraligamentous cyst and suspension of the uterus in 1927. Following the last operation, there was persistent pain. An X-ray showed adhesions to the anterior abdominal wall. Operation in April, 1929, by Dr. R. W. Wilson showed a right-angle kink in the ileum which was adherent to the right rectus scar from the previous operation. A Lane kink was also present. The transverse colon was held by a band to the anterior abdominal wall. The adhesions were severed and the Lane kink

relieved. This left a large rough area on the anterior abdominal wall as a site for future adhesions. An omental graft was removed from the edge of the great omentum and carefully sutured in place. A report early in 1933 says she is "perfectly well."

CASE VII.—*Graft Around Common-Duct Suture.*—D. S., female, aged forty-one years, had a cholecystostomy performed in 1915. She was admitted to the Methodist Hospital November 18, 1931. For five years she had suffered from epigastric pain, nausea and constipation. Operation revealed a thick white gall-bladder surrounded by adhesions and filled with stones. The colon and omentum were adherent to the abdominal wall. The gall-bladder was removed with difficulty. A severe hæmorrhage from the cystic artery occurred. The common duct was accidentally cut across. A T-tube was inserted, the ends were sutured together and a free omental graft was wrapped around the suture line and held by a tacking stitch. December 12, 1933, had no pain or jaundice, but was costive.

CASE VIII.—*Graft Between Liver and Duodenum.*—M. R., female, aged forty-three years, had a cholecystectomy in 1927 and was well until four months before admission to the Methodist Hospital February 25, 1931. Her chief complaint was pain along the right side of the abdomen, nausea and vomiting at frequent intervals of large quantities of dark greenish sour fluid and she was very costive and had lost much weight. X-ray showed duodenal stasis but no dilatation. At operation, the whole colon was dilated and there were many adhesions from the ascending colon to the parietal peritoneum. The liver was also adherent to the parietal peritoneum above and the duodenum below. The adherent organs were separated and a free omental graft was tacked down over the duodenum and brought up over the edge of the liver. November 29, 1933, says she is feeling well and has no vomiting.

CASE IX.—*Graft to Liver Edge.*—G. C., female, aged fifty-four years, had a cholecystotomy in 1929. Six months later, began to have pain in the right upper quadrant radiating to the right scapula, and became much more costive. She was admitted to the Methodist Hospital June 16, 1931, and a cholecystectomy and appendectomy were performed. The gall-bladder was buried in adhesions and the edge of the liver showed a large raw area after its release. Two free omental grafts were used. One covered the edge of the liver and the other was interposed between the pylorus and the gall-bladder fossa in the liver. January 10, 1934, she was not very well. Had vague discomfort in the epigastrium and precordium and was still somewhat costive.

CASE X.—*Graft in Gall-Bladder Fossa for Hæmorrhage.*—R. M., female, aged fifty years, was admitted to the Methodist Hospital May 2, 1934. She was suffering from epigastric pain, hiccough and vomiting for three days. The gall-bladder was buried in the liver and adherent to the duodenum, stomach and colon. After removal, bleeding was rather profuse so a free omental graft was placed against the gall-bladder fossa and the liver sutured over it. The stomach and duodenum were also covered by attached omental grafts. Smooth convalescence. No sloughing out of the graft in the liver bed.

CASE XI.—*Graft Around Suture Line*—B. U. R., male, aged thirty-four years. Gastroenterostomy for duodenal ulcer in 1925 and another in 1930. Admitted to the Methodist Hospital August 26, 1931, with intestinal obstruction. At operation, a loop of ileum, about three feet from the ligament of Treitz, was found united to the stomach. There was no patent stoma. Coils of small intestines had slipped through the long loop and a volvulus had occurred. The old anastomosis was taken down and the opening in the jejunum was sutured and covered by a free omental graft because the peritoneum was absent. A new posterior no loop gastroenterostomy was performed and a jejunostomy. September 19, 1933, looks well. Has gained in weight. Has occasional attacks suggestive of duodenal ulcer.

CASE XII.—*Graft Over Suture Line.*—S. V., male, aged sixty years, was admitted to the Methodist Hospital March 21, 1932, with a perforated ulcer of the lesser curvature of the stomach. This was sutured and a free omental graft applied. An anterior long

loop gastroenterostomy was then performed by Doctor Renaud. June 11, 1933, had no indigestion, and looked well.

CASE XIII.—*Graft to Mesentery.*—A. F., male, aged thirty years, was admitted to the Methodist Hospital February 24, 1932, suffering from epigastric distress. Operation revealed a cæcum fastened by a congenital band to the parietal peritoneum. The terminal ileum ran vertically upward from the pelvis and its last six inches were fused to the posterior parietal wall. It was carefully loosened up, the peritoneal edges were brought together and an omental graft two inches by three inches applied to the under surface of the mesentery of the terminal ileum covering the raw area that was present. The appendix was removed. January 15, 1933, feels much better and has gained in weight.

CASE XIV.—*Graft to Terminal Ileum.*—F. G., male, aged thirty-two years, was admitted to the Methodist Hospital January 14, 1931, with right lower quadrant pain and constipation. At operation, an appendectomy was done. The terminal ileum was partially obstructed and a true Lane kink was found. The ileum was freed completely and a free omental graft sutured over the unperitonealized areas.

CASE XV.—*Graft to Terminal Ileum.*—N. R., female, aged fifty, was operated upon at the Methodist Hospital August 28, 1931. A suppurative appendix was present. The tip was adherent to the terminal ileum, leaving a raw infected area two inches square on the under surface of the mesentery of the terminal ileum after removal. A free omental graft was sutured in place covering this and a rubber tube placed for drainage. Home on the fourteenth day. Bowels moving without cathartics.

CASE XVI.—*Grafts to Ileum.*—J. F., female, aged forty-three years, was admitted March 10, 1931, to the Methodist Hospital suffering from lower abdominal pain and vomiting of two days' duration, due to a pelvic inflammation. Operation thirteen days later showed two distinct abscesses in the pelvis covered by adherent loops of ileum. The adhesions were severed, leaving a number of raw areas that were covered by suture and two omental grafts. A supracervical hysterectomy and bilateral salpingo-oöphorectomy were performed. Tube drainage to pelvis. Eight months later, January 19, 1932, bowels were moving much better. She occasionally takes mineral oil.

CASE XVII.—*Graft Around Murphy Button.*—H. H. DuB. had carcinoma of the rectum with intestinal obstruction from secondary involvement of the ileum. Was in the Methodist Hospital from November 7, 1932, to December 8, 1932. A Murphy button anastomosis was made between distended and collapsed loops of ileum. A free omental graft was placed around it. This patient was emaciated and had no tissue resistance. Later, a fæcal fistula occurred and the button was extruded. Death twenty-seven days post-operative. This would seem to offer no facts for or against the use of an omental graft.

CASE XVIII.—*Graft on Mesentery.*—W. P. E., male, aged forty-one years, had suffered from nausea and pain in the right lower quadrant for six months off and on. Was constipated. He entered the Methodist Hospital June 21, 1931. An obliterated appendix and several calcified lymph-nodes in the mesentery were removed. A free omental graft was placed over the raw area on the mesentery. In November, 1933, was free from pain, but still was costive.

CASE XIX.—*Graft to Base of Mesentery.*—E. B., female, aged twenty years, entered the Methodist Hospital December 12, 1931. For two months, she had suffered from attacks of nausea, vomiting and pain in the left lower quadrant. Operation revealed intestinal loops that were red, inflamed and matted together. A band of omentum was causing intestinal obstruction. At the base of the mesentery, there were many loops of gut adherent to the posterior parietal peritoneum. When these were separated, a raw area four inches square was left. This was covered by a free omental graft. The left ovary was resected and the appendix which was evidently the cause of all the trouble, was removed. January 2, 1934, her bowels are regular. She looks very well, but has an occasional gas pain.

CASE XX.—*Graft to Pedicle of Ovarian Cyst.*—A. W., female, aged seventy-one years, entered the Methodist Hospital May 21, 1931. Suffering from abdominal enlargement and pain. A large ovarian cyst was removed and the pedicle covered by a free omental graft. Smooth recovery.

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POST-OPERATIVE EVISCERATION

WITH AN ANALYSIS OF FORTY-FOUR CASES

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In the post-operative disruption of wounds, just as in other conditions in which the incidence is low, the number of reported cases small, and the experience of the individual physician and surgeon correspondingly limited, it is very difficult to obtain a proper perspective. Exclusive of the papers of Meleney and Howes, Colp, Grace, White and Heyd,[1] which make up the recent comprehensive symposium of the New York Surgical Society and which were published after we had begun this study, the literature of the last six years contains little more than a dozen articles dealing specifically with this subject, and the majority of them are based on very small series of cases. Even the New York symposium includes, with the discussion, a total of less than 175 cases, and the conclusions are drawn not from this total but from the individual series, the largest of which, fifty cases, is reported by Meleney and Howes.[1] The 712 cases collected by Sokolov,[11] chiefly from European clinics, are a very valuable contribution to the subject, but conditions in Europe in many ways do not parallel conditions in this country, and some similar detailed analysis of American cases might well be undertaken. It is a curious fact that the recent literature seems to include no contributions on the subject from English surgeons; one wonders whether the omission is accidental or whether this post-operative complication is actually no problem among them.

A study of wound disruption based upon the literature is literally a study in contradictions. We found practically no statement made by one writer on the basis of his own experience or his own analysis of a collected series of cases which was not contradicted with equal positiveness by some other writer with an equal right to speak with authority. The accident, for instance, is variously stated to be more frequent in males and in females, in youth and in age, in median and in rectus incisions, and in upper and lower abdominal incisions. It is with some hesitation, therefore, that we make our own contribution of forty-four cases, for it contains many facts and figures at absolute variance with the experience and beliefs of others who have preceded us in this field.

In the light of a personal experience of two cases of post-operative wound rupture upon our own service within a few weeks of each other, we expected to find a large number of cases of this accident, and were propor-

tionately surprised to be able to locate, by a most careful study of the hospital records, only forty-four cases over a period of ten years, which is an incidence too trifling to calculate. We were quite sure, again in the light of our own recent experience, that we should find the largest number of cases in malignant disease, but we really found almost 50 per cent. of the incidence in cases of appendicitis. We were quite sure, again, that we should find most of the patients well advanced in years, but we found only 20.4 per cent. over fifty years of age. And so it went. From our own very small series, therefore, we are attempting to draw no general conclusions, but the fashion in which our pre-conceived ideas were overturned did teach us one lesson, the importance of studying the actual facts of a given condition before leaping to conclusions about it from a few personal experiences that are fresh in the mind, as well as the danger of making deductions from unsubstantiated impressions.

That we have located every instance of post-operative evisceration which occurred in the New Orleans Charity Hospital over the last ten years we do not presume to say, but we are reasonably sure that we have located most of them, and the incidence, therefore, is clearly very small in proportion to the number of laparotomies done over the same period. The reported incidence varies widely and has not, we believe, always been calculated with due regard to all the circumstances of the case, particularly the type of service from which the statistics are drawn. Certain hospitals, for instance, treat only adults and others treat only children. Certain services treat only gynecological conditions, others handle no gynecological cases at all. A service devoted largely to the surgery of malignant disease is likely to have very different figures from the figures of a service devoted chiefly to general surgery. Such facts are difficult to evaluate statistically, and few of the reported series take them into account, this being one reason, we believe, for the wide discrepancies in the reported incidence, which varies from .03 per cent. to 3 per cent. In fourteen of the nineteen individual series reported by Sokolov,[11] the incidence is less than 1 per cent., and it is hard to determine on what grounds this particular author makes the statement that the true incidence is between 1.5 and 3 per cent. Certainly at Charity Hospital it does not remotely approach that figure, nor does it in any of the series reported from other American clinics. Grace[1] could locate only forty-six cases in fifteen years, Starr and Nason[12] found only fifteen cases in 2,455 laparotomies, Heyd[1] reports four cases in 2,125 personal cases, and four in one year in 1,000 consecutive cases on the public service, while the highest incidence recently reported (White,[1] seven cases in one year in 406 vertical incisions) is still a very low incidence.

The mortality, like the incidence, seems to us another point on which considerable confusion exists. The reported figures vary very widely. White[1] reports sixteen deaths in thirty cases, 53 per cent. Heyd[1] reports one death in four cases, 25 per cent. Meleney and Howes[1] report twenty-two deaths in fifty cases, 44 per cent. Grace[1] reports fifteen deaths in thirty-six cases, 41

per cent. Colp[1] reports eight deaths in twenty-six cases, not quite 28 per cent. From the foreign clinics Madelung reports in a collected series a mortality of 22 per cent., Sokolov's[11] mortality, also in a collected series, is 32.1 per cent., Holterman's runs to 47 per cent., and von Gusnar's[13] is highest of all, 80 per cent. in ten cases. It must be borne in mind, of course, that when the number of cases dealt with is small, every death counts for proportionately more.

In our own series of forty-four cases, there were thirteen deaths, a mortality of 26.25 per cent., but that all of these patients, or even most of them, died because their wounds ruptured is a most inaccurate assumption, although it is quite correct to say that many times the accident did precipitate the fatality. An analysis of the cases makes it quite clear that some of them would have terminated fatally even if the complication had not occurred.

Considering the cases first from the standpoint of operative risk (see Table I), of the twenty-six patients whom we estimated as good risks only two died, a mortality of 7.7 per cent. Of the eight whom we regarded as fair risks, four died, a mortality of 50 per cent., and of the ten whom we regarded as poor risks, seven died, a mortality of 70 per cent. In other words, the mortality, from this standpoint, increased in proportion to the degree of operative risk, and well over half of the deaths occurred in patients in whom death was probably inevitable anyway.

TABLE I

Operative Risk

	Cases	Deaths
GOOD RISK	26	2
Recurrent or subacute appendicitis	10	1
Acute appendicitis	8	
Uterine fibroids	3	
Foreign body in duodenum	1	
Inguinal hernia	1	
Intestinal obstruction	1	
Duodenal ileus	1	1
Duodenal ulcer	1	
FAIR RISK	8	4
Uterine fibroids	3	1
Cholecystitis	2	2
Pancreatic cyst	1	1
Ectopic pregnancy	1	
Acute appendicitis	1	
POOR RISK	10	7
Carcinoma of stomach	4	3
Uterine fibroids	2	2
Menorrhagia (essential hæmorrhage)	1	1
Post-operative adhesions	1	1
Papillocystadenoma of ovary	1	
Acute appendicitis	1	

Then we considered these cases in relation to the type of surgery done. In eighteen cases the surgery was elective, and in this group there was only one death, a mortality of 5.5 per cent. In fifteen cases the surgery was of the type we have chosen to call urgent; intervention had to be undertaken because of the urgency of the symptoms and the seriousness of the pathological process present. In this group there were eleven deaths, a mortality of 73.3 per cent., and the majority of the patients, we might add, also fell into the group of fair or poor risks. Finally, in the eleven patients in whom emergency surgery was done, there was one death, a mortality of 9.1 per cent.; this occurred in a patient with ectopic pregnancy, in whom primary and secondary hæmorrhage undoubtedly played as large a part in the fatal outcome as did the rupture of the wound. The mortality in this last group, we might say, proves again a point well established in the late War and repeatedly proved in civil practice, that the patient, other things being equal, who is stricken with sudden illness in the midst of health and who is cared for without undue delay, is an excellent surgical risk.

Even those authors who believe that post-operative wound rupture is a very serious complication *per se* grant that the underlying disease is even more important. In the majority of reported cases malignant disease is, almost without exception, the most frequent primary pathology, although the exact proportion is variable. We confidently expected, as we have said, that the same situation would prevail in our own series of cases, and it was surprising to find only five cases in the whole series falling into this classification, four of carcinoma of the stomach and one of papillocystadenoma of the ovary. Appendicitis, in only ten cases of the acute variety, furnished the original pathology in twenty cases, 43.2 per cent. of the total number, and uterine fibroids came next, eight cases, 18.1 per cent.

Why this curious reversal of the experience of other surgeons should exist we do not know. Perhaps the incidence of wound rupture in malignancy is so small because the accident is often anticipated in this disease and precautions are taken to prevent it, but surely the same precautions are taken in other clinics, in which the incidence of rupture in this disease is relatively high. Ten of the twenty cases of appendicitis were drained, and drainage is admittedly a predisposing cause of wound rupture, but it cannot be a very important one, for the total number of ruptured cases is very small in proportion to the total number of cases drained. Still more confusion is added to the group of appendicitis cases by the fact that in six of them the McBurney incision was used, after which wound rupture is practically never reported. The number of ruptures after operation for uterine fibroids we do not find surprising in this hospital, where the incidence of the disease, and in an extreme form, is very high among colored women, in whom all of these cases occurred.

The distribution of the cases by years is entirely out of proportion to the yearly hospital admissions and to the amount of surgery done. Surely there was at least as much surgery done in 1925, when there were no disruptions, and in 1926, when there were only two, as in 1924, when there were five.

There were seven disruptions in 1927, but only one in 1928 and one in 1929. Again, there were thirteen cases in 1933, when the number of admissions was practically the same as in 1932, in which year there were only five. The explanation for at least one of the earlier years is probably the trial use of different varieties of catgut, some of which proved to be of an inferior quality, but for the other discrepancies we have no reasonable theory. We wonder whether the inevitable explanation of the depression and the deficiency diseases that accompany it might be invoked to explain the increase in 1933. The cases in that year included thirteen varieties of disease and were handled by thirteen different surgeons, so neither the underlying pathology nor the personal equation covers the situation. In this connection it is interesting to note that White[1] was moved to study his series by the fact that the percentage of disruptions under his observation had materially increased in 1931.

We might also add, in reference to the personal equation, that no surgeon is safe from the catastrophe, regardless of the excellence of his technic. Twenty-seven individual surgeons are represented in this series, and although one surgeon appears seven times, and another five, the explanation in the first case seems to be the experiments with catgut to which we have already referred, while in the second it seems to be the combination of unfortunate circumstances which at intervals dogs the footsteps of even the best of surgeons.

Sex, in our opinion, plays no important part in the accident. The incidence in the various reported series seems to depend upon whether or not gynecological admissions are included in the cases studied, although Sokolov[11] believes that when due allowance is made for this consideration, the incidence is predominantly male. Colp[1] also believes that the accident is more likely to happen to the male than to the female, because women have a certain biological superiority over men in their endurance of surgical trauma. In our own series, twenty-one patients were male and twenty-three female.

The age incidence, which ranges from two to seventy-two years, and which includes two cases under ten years, eleven each under twenty and under thirty, six under forty, five under fifty, six under sixty, two under seventy, and one over that age, differs from that of many reported series in that the greatest incidence, 63.6 per cent. (twenty-eight cases), occurred between ten and forty years of age, instead of over fifty years. Von Gusnar's[13] series, in which eight of the ten patients were between fifty-four and seventy-four years, is an extreme instance. In our own series the age incidence is to be explained by the predominating incidence of appendicitis, which is a disease of youth and early adult life. It is rather surprising, however, not to find more cases late in life, and to find no cases in young children with pyloric stenosis, in whom malnutrition is always a factor to be reckoned with. As a matter of fact, the one infant who disrupted in this series had had a duodenotomy for the removal of a foreign body, there was no infection, and while the child did exhibit some restlessness during the first days of his convalescence, it does not seem to be sufficient to explain the evisceration.

The seasonal incidence, upon which Sokolov[11] lays so much stress, we consider unimportant. It is true that twenty-eight of our forty-four cases occurred in the summer and fall, but in so small a series this amounts to very little, particularly in view of the fact that for some reason in this community elective surgery is most frequently done at those times. In Sokolov's series, the great majority of cases occurred in the first six months of the year, and his theory is that they are to be explained by a deficiency of Vitamin C in the diet. We doubt whether such an explanation would be tenable anywhere in this country. It certainly would not in the South, where fresh fruits and vegetables are available all the year round. We might add, at this point, that respiratory infections, which are so important in the winter months in colder climates, and which undoubtedly figure in the etiology of wound dehiscence, are of relatively small consequence in this part of the country at any season of the year.

Striking dissimilarities between the white and the Negro patients, which we had expected to find in this series, just as we do in most conditions, we failed to find. The Negro incidence of 38.6 per cent., seventeen cases, against the white incidence of 61.4 per cent., twenty-seven cases, is slightly less than the hospital proportion of Negro to white patients. An interesting consideration, however, is that twelve of the ruptures occurred in colored women, and that eight of the twelve, 75 per cent., were after operation for uterine fibroids. Indeed, all the ruptures in uterine fibroids occurred in colored women, which is about what would be expected by a surgeon familiar with this disease in this race. Even in these modern days one frequently sees tumors of enormous size, often with the added complications of ovarian cysts and pelvic infections of incredible extent and severity. As a result, the peritoneum and the whole abdominal wall are relaxed after the tumors are removed, atrophy of the structures is apparent, and the peritoneum actually seems thinned out from the tension under which it has been for many years. In no other reported series is the Negro incidence emphasized, and we take it for granted, therefore, that the Negro, as usual, presents problems in this part of the country which he does nowhere else.

Anæsthesia seems a matter of no special consequence, which, in a way, is curious, if one recalls the many cases in which the abdomen is closed forcibly and under tension, while the patient strains under a badly given or badly taken general anæsthetic. In only one case in our series, an appendectomy for recurrent appendicitis, did anæsthesia seem to play any part. In this case full relaxation was never secured under spinal analgesia, even with the addition of local, and closure was effected under such difficulties that specific precautions, though without avail, were taken to forestall evisceration.

Regardless, however, of age, sex, personal equation, operative risk, underlying pathology, anæsthesia, or any similar consideration, wound rupture occurs in all cases because of one fundamental consideration, some interference with the process of wound healing. The nature of that interference

is not yet clearly understood. The first stage of wound healing, as Howes, Sooy and Harvey[8] point out, is a "lag" period of four or five days, which is characterized by fibrin formation in the blood or plasma exuded between the surfaces of the fresh wound; after this period comes the period of "fibroplasia," which is characterized by multiplying fibroblasts and sprouting blood-vessels. Hertzler's[4] "newer conception" is that wound healing is a chemical process, in which the wound is agglutinated by fibrin fibrils which remain to form adult fibrous tissue, the product of fibroblasts being present only when there has been some interference with the normal processes.

Whatever theory be accepted, the important consideration, from the standpoint of wound disruption, lies not so much in the mechanism by which the process of wound healing is effected as in the fact that during the first days of the process, the "lag" period of Howes and his co-workers,[7, 8] the approximation of the incised tissues is dependent upon their mechanical coaptation by the sutures. During the second period the wound begins to develop its own holding power, and after the tenth day its tensile strength reaches a maximum comparable with that of unincised tissue. Healing, to quote Howes [5, 6, 7, 8] again, is dependent in the first stages upon the number of sutures and their holding power; the reaction of the tissues to them, which is comparable to the reaction of tissues to any foreign body, is a part of the healing process.

Speaking, then, only of absorbable sutures and of the normal process of healing, it is clear that during the period when the wound itself is weakest the sutures are strongest, and that when the sutures begin to lose their strength, the wound becomes increasingly strong. But it is clear, also, that there is a period when the balance between the loss of strength by the sutures and the gain of strength by the wound is a very delicate one, and it is not surprising, therefore, that the highest percentage of wound disruptions should occur within this period, which is ordinarily considered to be between the seventh and the tenth days. Twenty-six of Grace's forty-six cases occurred then, as did thirty-two of Meleney and Howes[1] fifty, and twenty-two of our own forty-four.

But disruption can occur at other times. Colp, Grace, and Meleney and Howes[1] report the accident on the second and third days after operation, and it occurred on the third day in our own series in the case of ectopic pregnancy we have already mentioned. In thirteen of the cases collected by Sokolov,[11] it occurred after the twentieth day, in one instance as late as the twelfth year post-operative. We were particularly interested in these late ruptures, for the reason that in seven cases of our own series the accident occurred after the fifteenth day, and in one case on the seventeenth day. Three patients who had been discharged from the hospital returned on the third, the fourth and the seventy-fifth day thereafter with ruptured wounds. The first patient, a case of recurrent appendicitis, had had a perfectly smooth convalescence and was discharged apparently in excellent condition and with a perfectly healed wound. In the second case, which terminated fatally, as

the result of an intestinal obstruction, the accident could have been anticipated, for there was a typical serous discharge from the wound from the sixth day onward, and to remove the sutures and discharge the patient in the face of it seemed to be courting the disaster which occurred. The third patient had had an appendectomy and colostomy done elsewhere for a ruptured appendix, and the healing of the resulting fecal fistula was apparently never more than superficial. Evisceration on the sixtieth day after discharge was precipitated by a violent coughing spell.

The literature differs, as we have intimated, as to the type of incision through which rupture most frequently occurs. Grace, White, Lahey and Clute,[2] and Howes and Meleney believe the accident is most frequent in upper abdominal incisions, although Howes[1] adds the qualification that gynecological cases must be taken into account before generalizations are made. In Sokolov's series, 76.4 per cent. of the cases were in mid-line incisions, usually upper mid-line incisions, and Howes shares his opinion that this type most frequently predisposes to rupture. The majority of Grace's cases occurred through rectus incisions.

In our own series only eleven of the incisions, 25 per cent., were upper abdominal, which is to be explained, of course, by the low incidence of upper abdominal disease. The same reason accounts for the fact that only sixteen of the forty-four incisions were in the mid-line. But other circumstances are not so easily accounted for. Why six McBurney incisions ruptured is, as we have already said, beyond explanation, as is the rupture which occurred in one instance after an operation for direct inguinal hernia. We were inclined to throw the latter case out until we had examined the record in detail, and then there seemed no doubt that it should be included. The patient was a very obese woman, and perhaps fat necrosis played some part; a severe infection necessitated the removal of the sutures on the ninth day, and the incision opened throughout its length on the seventeenth day. We do not find the accident reported after an incision for hernia or after the McBurney incision in any other study, and the statement is occasionally made that both these incisions offer a definite protection against it, a statement which obviously does not hold in the face of our own experience.

The length of the incision, it seems to us, makes no special difference, since wounds heal from side to side and not from end to end. We make that statement with more positiveness for the reason that in this hospital we have so often seen perfect healing in the very long incisions sometimes necessary to remove the large pelvic tumors which colored women are wont to exhibit. Colp believes that incisions through previous scars are unlikely to separate, but rupture followed one such incision in our series.

All of our cases were closed in tiers, as is the almost universal custom in this country, although we judge from Sokolov's report that our closure in tiers and the Continental method differ radically, the latter frequently including as many as five separate layers. Thirty-nine cases were closed with continuous catgut, three with interrupted catgut, one with interrupted linen,

and one with interrupted silkworm gut. In the last two cases, one a pancreatic cyst and the other a carcinoma of the stomach, trouble was anticipated and special precautions taken to guard against it.

Our own conclusion is that rupture is possible with any type of suture material and in any type of closure. One of us (U. M.) has seen the accident only after closure with continuous catgut, while the other (F. F. B.) had seen it prior to his arrival in this community only after closure with interrupted silk and catgut. It is Sokolov's opinion that rupture is more frequent with catgut than with silk, the basis of his statement being the fact that although the former material was used less frequently in his series, the incidence of disruption with it was proportionately greater than with silk. The use of silk, as advised by Whipple,[14] is in our opinion advantageous rather because of the meticulous technic which it requires than because of any virtue inherent in the material itself, a point of view which Howes seems to share.

In twenty-eight of the forty-four cases the sutures had been removed, the day of removal varying from the fifth to the fourteenth day. Speaking categorically, we would say, in view of our knowledge of the stages of wound healing, that the fifth day is rather too early to remove sutures in any type of incision or any type of disease. Some writers make the point that the presence or absence of the sutures plays no special part in the production of the accident, but we cannot agree with them. Too many wounds in this series ruptured too promptly after the sutures had been removed to make the sequence of events anything but cause and effect. In many cases the descriptions, unfortunately, are very inadequate, but in a few it is specifically stated that the catgut lay free in the wound, while in a few others it is stated that there was no eivdence whatsoever of the suture material, these latter evidently falling into the category of cases described by Erdmann, in which, as the result of tissue hunger, the suture material is digested too early.

In twelve of the forty-four cases it is stated that retention sutures were used, and we have no doubt that they were used in at least as many more; too many surgeons, unfortunately, are inclined to let the expression, "my usual technic," cover the situation. As to their value there is considerable discussion. Certain surgeons have largely given up their use, on the ground that they serve no special purpose and predispose to infection. Certain others advise their use as an adjunct in suspected cases. Still others use them routinely. The point to be made, however, is that rupture apparently occurs quite as often with them as without them, which is not surprising, in view of the fact that they do not enter the peritoneum, and that the peritoneum is the layer in which rupture first occurs.

Wounds which rupture post-operatively can be divided into two great classes, those which are grossly infected and those which are apparently clean, though many of the latter, it must be remembered, are microscopically unclean. How important a part infection plays in wound rupture is a disputed matter, and it cannot be denied that only an infinitesimal proportion of

infected wounds suffer this fate. It must be granted, too, that in the characteristic case dehiscence is not associated with gross infection, though it must likewise be granted, as Howes and Harvey[7] point out, that infection always means a premature loss of tensile strength.

Nine of the forty-four cases we studied were grossly infected, though in one case the rupture and the infection were both discovered only when a second-stage operation was about to be performed. In five cases the infection was unquestionably due to contamination from a ruptured appendix, and in another case it was associated with an acute pelvic condition for which operation had been undertaken on the mistaken diagnosis of acute appendicitis, but how it entered in the other cases is not clear. It is interesting to note that in eight cases in which no infection was evident when the secondary closure was done, the post-operative course was characterized by rather severe wound infections, and that in two of the three cases in which still another closure was necessary, infection had followed the first operation. Sokolov reports an incidence of infection of 15.7 per cent. in his collected cases, and says that so many authors emphasize the importance of this complication that he went over his material a second time to be certain that he had not overlooked any other case which should have been so classified.

Inadequate hæmostasis seems to play a part similar to infection. Freeman[3] says that he has never seen a hæmatoma in a ruptured wound, but Meleney and Howes point out that such collections predispose to infection, which certain cases in this series seem to prove. It may be that Freeman's statement is based on the fact that at the time rupture occurs, any hæmatoma which may have been present is likely to have disappeared.

Drainage undoubtedly furnishes a predisposition to infection if infection does not already exist; in the ten cases in this series in which it was done, all for acute appendicitis, the wounds were already either actually or potentially infected at the time of the first operation. The institution of drainage, furthermore, offers an opportunity for the protrusion of the abdominal contents by providing a ready-made exit for them.

That statement brings us to the theory of the mechanism of wound rupture advanced by Freeman, which is undoubtedly the most reasonable of any theories so far advanced. His idea is that through an opening in the peritoneal layer, which may be present as the result of inadequate closure, a wedge of omentum protrudes immediately post-operative, the opening becoming larger and the wedge protruding still more as the post-operative course advances. His reasons are very plausible: that the omentum is likely to prolapse in the normal course of events, as manifested by its tendency to enter the wound when primary closure is undertaken; that rupture occurs most frequently in the central and lower part of the abdomen, where the omentum is most in evidence; that omentum is practically always present in ruptured wounds, its swollen state and the associated adhesions suggesting that the prolapse has occurred some time previously rather than with the rupture; that its incarceration is manifested clinically by the symptoms of

obstruction which frequently appear in such cases very soon after operation; and that its swollen state is protection against further rupture when the secondary closure is done.

Moschcowitz, in 1916, advanced a rather similar theory, though he limited it to the closure of upper abdominal incisions in obese patients with biliary disease, his idea being that the holes in the suture line, which were likely to be present whenever closure was done forcibly and under tension, provided an opportunity for the omentum to prolapse. Clute's idea is that if the transversalis fascia is not closed as carefully as the peritoneum, there is likely to be a lateral pull on the peritoneal suture line, and a consequent prolapse of the omentum. Lahey believes that rupture is often due to failure to approximate properly the split bellies of the rectus muscles, a trough thus being left between the fascia and the peritoneum in which serum tends to accumulate.

It would be most unreasonable to assume that the post-operative course, however stormy, is entirely responsible for wound rupture, but it is surely reasonable to assume that it is an added factor in those cases in which the peritoneal closure is inadequate or in which some constitutional deficiency causes too rapid absorption of the suture material. Starr and Nason[12] separate the post-operative course in cases of wound rupture into three clinical groups. In the first, the course is stormy from the outset, characterized by distention, nausea, vomiting, hiccoughs and similar symptoms and signs, and requiring the frequent use of the stomach tube. In the second group the course is smooth, except, perhaps, for an occasional slight and unexplained temperature elevation, and rupture is unsuspected until after it occurs. In the third group are the patients in whom this or any other complication can be anticipated because of the seriousness of their disease, the underlying cachexia which is responsible for indolent healing, and the low-grade sepsis which is frequently present.

In ten cases in our series the post-operative course was perfectly smooth except for a late, slight temperature elevation in four cases. In four other cases the course was at first smooth, but later symptoms of partial obstruction developed. In sixteen cases the course was moderately stormy and in twelve it was very stormy. Two patients exhibited throughout an apathy and weakness which were disturbing and for which there seemed no special cause.

Distention and vomiting occur too frequently, especially immediately after operation, when the strain on the suture line is obviously greatest, to explain very satisfactorily any cases of wound disruption, but their importance in connection with other factors is apparent. We are impressed, too, by Meleney and Howes' suggestion that distention is quite as often an effect of disruption as a cause, and by their idea that a sudden strain is a more potent cause of the accident than is the gradual strain of distention. In seven cases in our series the rupture was precipitated by vomiting, in three by a coughing spell, in three by violent hiccoughs, in one by a sudden movement, and in another by the passage of a stomach tube immediately after the sutures had been removed. That is, in practically a third of the cases, none of them, by

the way, associated with infection, and probably in others in which observation was less careful, a sudden strain apparently brought about the accident. In three cases rupture was discovered by a casual inspection of the wound, and was entirely unexpected and unheralded.

In twelve patients, two of whom had pneumonia, a post-operative cough was clearly a predisposing cause of the rupture. The incidence of post-operative pulmonary complications, as we have noted, is very low in the South, regardless of the time of year, but the effect of coughing is the same in any climate. Sokolov is inclined to lay great stress upon the importance of pulmonary complications, and considers that the percentage in his own series, 37.17 per cent., is the minimum.

The symptoms and signs of rupture, actual or impending, are not always clear. Persistent or late vomiting, particularly when the abdomen is soft, demands prompt investigation, and we agree with Lahey that even if the wound seems superficially intact, it is wise to investigate the state of the underlying structures by the introduction of a sterile probe. A serous or serosanious discharge is an important warning sign. It was mentioned in seven cases in our series, but was probably overlooked, or, more correctly, not noted on the record, in many others. It was ignored in one case, as we have said, with tragic results. Inspection of the wound is always necessary without delay when the patient reports a sense of something having given away. Heyd mentions the peculiar cadaveric odor sometimes apparent before rupture, and we recollect having observed it ourselves in one case, associated with a severe wound infection, in which, however, death occurred before the peritoneal layer gave way.

That case reminds us of others in which, so to speak, death wins the race. We recall offhand not only the one we have just mentioned, but several others seen in private practice and in our wards in Charity Hospital, in which omentum and intestines were actually protruding from the angle of the wound before the patient died. Moschcowitz mentions Sprengel's report of patients seen at autopsy who died shortly after operation and in whom a complete separation of the peritoneal suture line was noted, and we questioned our own pathologists on this point, which we do not recollect having seen emphasized elsewhere. Two of them stated that they saw such cases possibly twice a year. Another, with wide experience in the autopsy room in Viennese clinics as well as in this country, told us that he had never observed such a condition. The fourth and senior pathologist informed us that he had seen no case recently, but that he clearly recollected several instances some years ago, within a comparatively short time, it being his opinion that this period coincided with the period we have already mentioned, in which a test of several grades of catgut was being made.

Secondary closure was done immediately in thirty-six cases and was deferred in eight, in six because of gross infection and in two others for reasons that are not apparent. *En masse* closure was done in twenty-six cases with through-and-through sutures, which were also used in three cases

in which closure was done in tiers; ten cases in this group terminated fatally. In the remaining fifteen cases closure was done in tiers, without through-and-through sutures, and in this group there were three deaths. The mortality rates, however, have in our opinion no relation to the method of closure employed; the patients who were most seriously ill were obviously closed in the quickest possible fashion, and they died of their disease and because of their condition rather than because of the way the secondary closure was done.

The silver wire method of suture suggested by Shipley[10] for disrupted wounds was not used in any case in this series, nor was the tampon method advocated by Colp and others, particularly for cases associated with peritonitis, shock or other grave complications. This method, so far as we can discover, is seldom employed in this community, and we have, therefore, no comparative figures of our own. In Sokolov's series the mortality for immediate secondary closure was 32.1 per cent. (132 of 411 cases) against a mortality of 35.46 per cent. (seventy-two of 203 cases) for the tampon method. The tampon method, he concludes, is the safer, for the patients in whom it was employed were the most seriously ill, and the results in the other group would have been better, he believes, had it been used, though he grants that it predisposes to adhesions and introduces the possibility of later obstruction.

Sokolov and other writers make the point that secondary suture is usually followed by smooth healing, since it introduces the factor of irritation which is essential for closure and which in such cases is absent at the time of the first closure. Here, again, we must differ, for of the thirty-one patients in our series who lived, ten had a very stormy post-operative course and another developed pneumonia. Furthermore, eight previously uninfected cases developed wound infections, in five cases secondary healing was materially retarded for some reason or other, and in three cases further suturing was necessary. It was notable in all of these cases that the best results were achieved and convalescence was smoothest when secondary closure was done without delay, even though infection were present.

Of the thirteen deaths, seven were due to peritonitis, in one case with an associated obstruction and in another with an associated pneumonia. One death was due to ileus and hæmorrhage, and five were due to shock. In all of the latter cases, however, we considered the underlying conditions as more truly the cause of death than the accident that immediately precipitated it. The high percentage of deaths from peritonitis is in distinct contrast to the statement of certain authors that this complication is not very usual in wound dehiscence.

The prophylaxis of post-operative evisceration, as based upon the cases we have studied, seems to begin with the proper pre-operative preparation of debilitated and chronically ill patients. In at least four of these cases the pre-operative preparation was startlingly inadequate: a patient who is operated upon, for instance, with a hæmoglobin of 40 per cent. is not a safe risk, any more than is a patient who is operated on with an icteric index of 90.

Of suture material we do not care to speak dogmatically. We personally

believe that catgut, used, as Howes advises, with the "silk technic," is probably as safe as silk, and we question the wisdom of advising the general use of silk. That Doctor Whipple[14] has achieved brilliant results with it does not mean that Doctor Doe and Doctor Roe will necessarily achieve them too; they are rather more likely to make difficulties for themselves and for their patients. Nor do we agree with White that the use of braided silk sutures should be routine in doubtful cases; such sutures, it seems to us, are rather too heavy for safety, and they are not necessary if our present conception of wound healing and of the tensile strength of suture material is correct.

Special precautions should clearly be taken in closing the wound in those patients in whom surgery is necessary in the presence of extreme old age, general debility and weakness, cachetic disease and long-standing distention. If such precautions fail, as they sometimes do, and as they did in three cases in this series, at least one has the consolation that one has made the effort.

We ourselves devised some years ago a special mattress suture for the closure of the aponeurotic plane, with which we believed evisceration could not occur. Its description and illustration was to be an important part of this paper. But pride ever goes before a fall, and while we were collecting our material, one of our patients with carcinoma of the stomach in whom this stitch had been used and in whom other precautions against rupture had been taken ruptured her wound as completely and as thoroughly as any patient we had ever seen. There was not the smallest evidence of healing, the incision looked as fresh as if it had just been made, and our mattress stitch, we reluctantly concluded, must be set down as one more failure.

One method of prophylaxis, however, does seem to have achieved results, the silver-wire technic advised by Mont Reid,[9] which has been in use at the Cincinnati General Hospital for some ten years. During that period, according to Reid's report, eight ruptures occurred in wounds closed by other methods, but not a single rupture occurred in the 334 suspected cases in which silver wire was used, and in only two of them was there evidence of the slightest tendency toward dehiscence. This unique and brilliant report clearly warrants the general adoption of this method, or some similar one, in an endeavor to avert a catastrophe that is always potentially disastrous and that frequently terminates fatally.

NOTE.—As this paper was being typed in its final form, we were notified from the operating room of the occurrence of another case of wound rupture, and were given the opportunity of observing it by the courtesy of Dr. W. A. Ellender, of the Charity Hospital house staff, who was closing it. The patient, a girl of eight years of age, had been operated on six days previously for an intussusception of forty-eight hours' duration. Closure had been effected with some difficulty, and a hæmatoma formed in the wound as it was being done. Convalescence was complicated by a racking cough. There was, however, no sign of impending trouble, and the rupture was discovered in the course of the morning dressing; there had been no evidence of it on the preceding day. The catgut sutures were entirely undigested, the wound gave only slight evidence of healing, and the peritoneum was so friable that closure in tiers

was done (under local analgesia) with considerable difficulty. The child was in excellent condition, and there seems no reason to anticipate anything but a successful outcome. The "omental wedge" of Freeman was clearly seen protruding through the peritoneal edges, which were loosely held together by the undigested catgut, and we were impressed again with the soundness of this author's explanation of the mechanism of wound rupture.

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THE FUNCTION OF PERIPHERAL VASOCONSTRICTION

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The trend of study and treatment of individuals with peripheral vascular deficiencies during the past ten years has been to emphasize vasoconstriction as an important etiological factor. The occurrence of a varying degree of peripheral vasoconstriction in normal individuals has been recognized but little mention has been made of the physiological principles involved. When vasoconstriction is demonstrated by various tests in the extremities of patients with peripheral vascular deficiencies, it is seldom referred to as vasoconstriction but is generally regarded as a pathological phenomenon and is termed vasospasm. In cases in which the lesion is primarily occlusive in character, the process is commonly considered as "vasospasm of the collateral circulation" or "superimposed vasospasm." A study of the function of peripheral vasoconstriction in the normal individual makes it clear that vasoconstriction in the extremity of patients with peripheral vascular disease is not always pathological. A statement of the physiological processes concerned is necessary to an understanding of the problem under discussion.

Physiology.—In the human machine as in other machines, a large part of the energy transformation is dissipated as heat. By means of a nice adjustment between the amount of heat produced and the amount of heat dispersed, the internal body temperature is normally maintained at a fairly constant level in spite of rather wide variations in both heat production and environmental conditions. For the average range of activity short of physical labor, carried on at comfortable temperatures and humidities, approximately 76 per cent. of the total heat loss is dissipated by radiation, conduction and convection from the skin, and 24 per cent. by the vaporization of water from the skin and lungs.[1] In cold weather, the addition of clothing usually prevents an excessive loss of heat. If this protection is insufficient to permit the maintenance of a normal body temperature, the production of heat is increased by shivering.[2] In hot weather, less heat can be dissipated by radiation, conduction and convection. The necessary compensation occurs by increasing the vaporization of water from the skin. At the peaks of temperature and humidity, this process may account for 100 per cent. of the total heat dispersed.

The temperature of the skin at any one point is a resultant of the heat brought to it largely by its blood supply and of the heat dissipated from its surface by the processes just mentioned. The two important factors leading to the adjustment of skin temperature are the amount of heat to dissipate and

the temperature and humidity of the environment into which it has to be dissipated. In a recent publication[3] we showed that with increased heat production or with increased environmental temperature, the shift of blood to the surface of the body as part of the temperature-regulating mechanism is not a uniform shift but occurs to a much greater degree to the surface of the extremities than to the surface of the head and trunk. The extremities then play a much more important part in the regulation of heat dissipation than does the remainder of the body. The purpose of this paper is to present simple data demonstrating this occurrence and to point out that the process involved is the one mainly responsible for the presence of and greater degree of vasoconstriction in the extremities than elsewhere on the body surface. Comments will also be made on the application of the facts presented to cases of peripheral vascular occlusion.

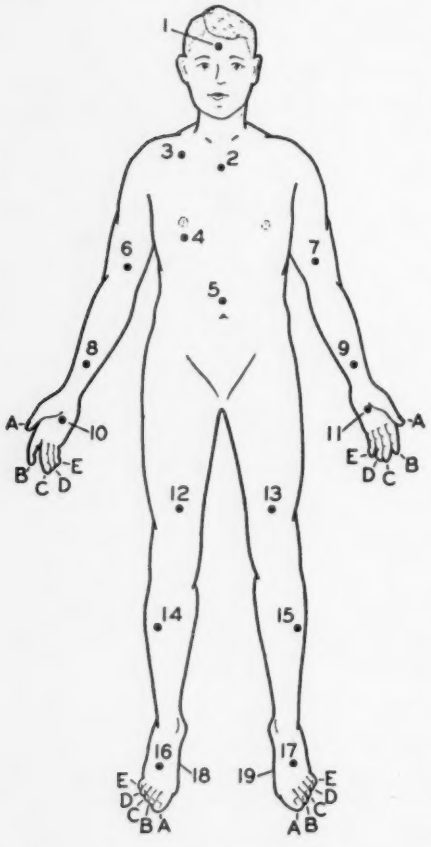

FIG. 1.—The points of skin-temperature measurement.

Procedure.—The investigation was carried out in a room in which the temperature and humidity could be kept constant. Young adult male subjects were studied under the conditions required for the determination of basal metabolic rates. Clothing consisted only of "shorts." Tobacco smoking by the subjects was not permitted for the two hours previous to the study because it produces peripheral vasoconstriction.[4] Also, ordinary psychic factors which change general vasomotor tone and thus easily produce changes in peripheral skin temperature were eliminated as much as possible. The dissipation of heat was determined for all subjects except those shown in Fig. 3. This was a comparatively simple procedure since under the resting conditions used the amount of heat dissipated equals the amount of heat being produced. The heat production which will be referred to from now on was determined by indirect calorimetry using the Tissot tank and Haldane gas analyzer. The common unit of reporting such values is used, *i.e.*, in calories per spare metre of body surface per hour, C/M2/Hr, and in the per cent. of the normal basal metabolic rate. For a few of the subjects the per cent. of heat dissipated by the vaporization of water was calculated from a determination of the insensible loss of weight for the period under study.[5] The skin

temperatures were recorded with a "Tycos Dermatherm" after a state of equilibrium had been reached. The points of measurement are shown in Fig. 1. Their distribution is largely on the extremities because they were originally selected for the study of peripheral vascular diseases. The points for the head and trunk are fairly representative of those areas.

Results.—The data are presented in such a manner as to show the independent effect on surface temperature of environmental conditions and of heat production, these being the two important factors involved in the adjustment of skin temperature. Emphasis is placed only on facts pertinent to this paper.

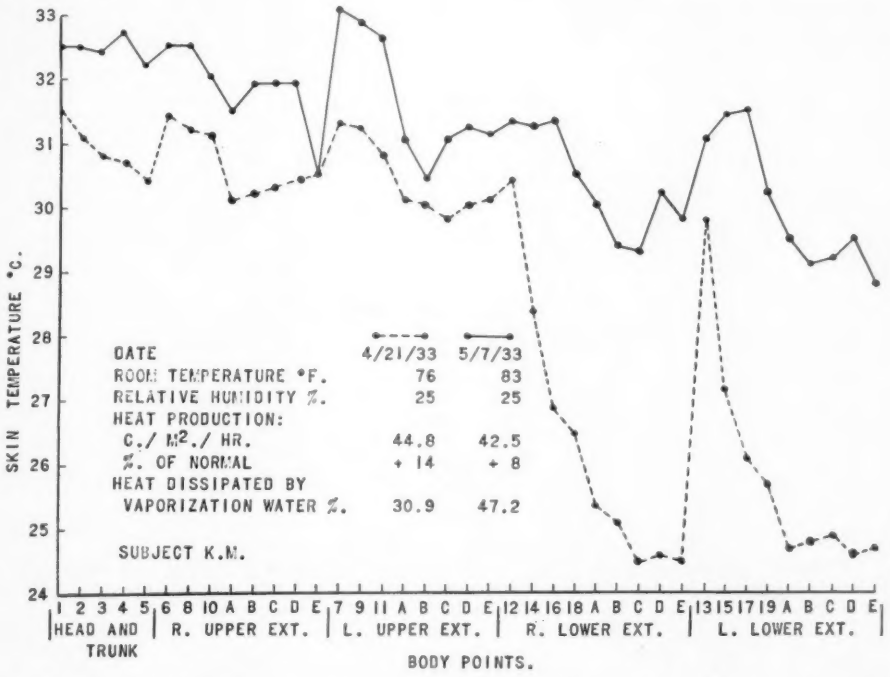

FIG. 2.—The surface-temperature response of a single subject to an increase in environmental temperature.

The Surface Temperature Response to Increased Environmental Temperature.—The result obtained from a single subject, K.M., is shown in Fig. 2. The important factor is the increase in the room temperature from 76°F. (24.4°C.) on April 21, 1933, to 83°F. (28.3°C.) on May 7, 1933. The heat production at the time of the two periods of study was not exactly the same but as the higher figure occurred on the day of lower room temperature, the difference in heat production did not exaggerate the effect of increasing the environmental temperature. The important results are (1) a general increase in surface temperature; (2) an increase in the amount of heat dissipated by the vaporization of water from 30.9 to 47.2 per cent.; and (3) a much greater increase in the skin temperature of the lower extremities than that of the remainder of the body.

The effect of an increase in environmental temperature and humidity on the surface temperature of a group of subjects is shown in Fig. 3. The curve "A" shows the average surface temperatures obtained after an exposure of the subjects to a room temperature of 25°C. for one hour, the relative humidity being 25 per cent. Curve "B"

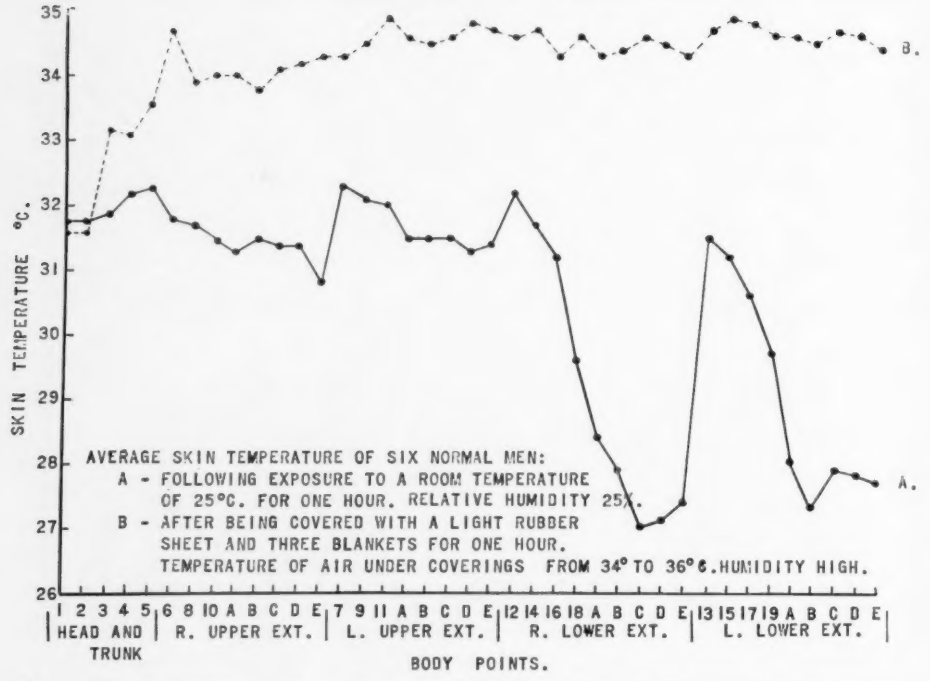

FIG. 3.—The surface-temperature response of a group of subjects to an increase in environmental temperature and humidity.

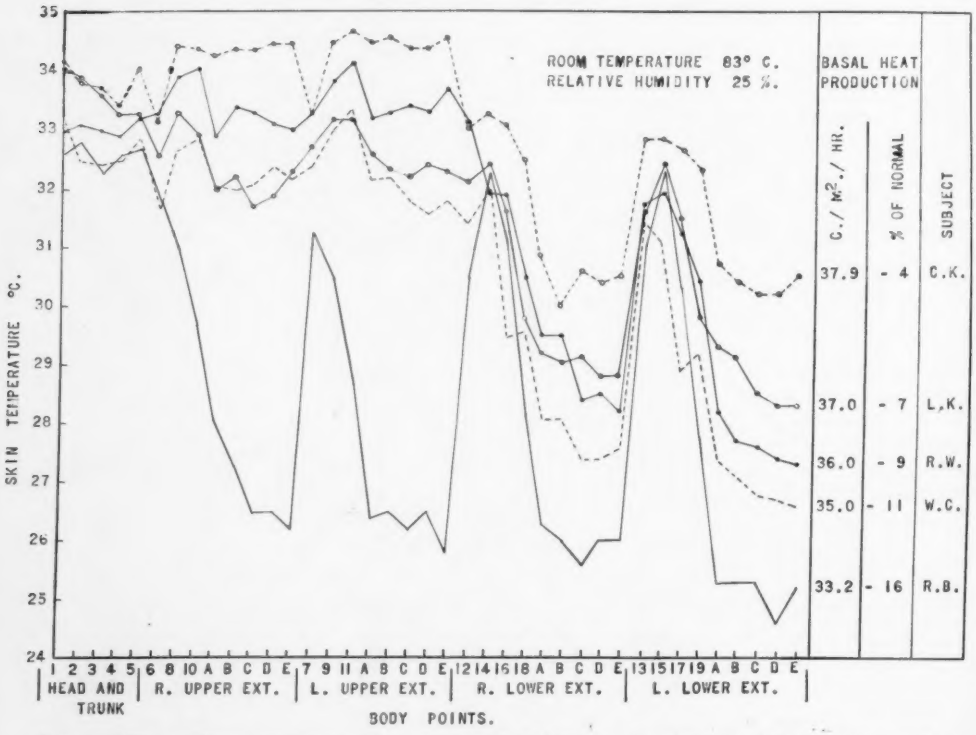

FIG. 4.—The surface temperature of a group of subjects at the time of obtaining their basal metabolic rate, the environmental conditions being constant.

was obtained after the subjects had been covered up to the clavicular line with a light rubber sheet and three blankets for one hour. The air temperature under the coverings varied from 34° to 36°C. The relative humidity was high as the skin and under surface of the rubber sheet were covered with moisture. The heat production of these subjects was not determined since it had been shown that such increases in environmental temperature and humidity do not materially affect this factor.[2]

The result obtained from the study of the group is the same as that of the single subject, K. M., of Fig. 2. The period of exposure offered ideal conditions for the dissipation of heat. As a result, surface temperatures are only moderate and varying degrees of peripheral vasoconstriction are present, and are most marked in the lower extremities. The elimination of heat in the hot and humid environment under the coverings is a more difficult matter. The adjustment was a considerable transfer of blood to the surface of the body, the greatest actual shift being to the lower extremities, next greatest to the hands and arms. Excepting the exposed points on the forehead and upper sternum, the temperatures of curve "B" are all above the "normal vasodilatation level" of Morton and Scott.[6] For several years we have used this "environmental response"[7]* as a satisfactory test in the study of peripheral vascular deficiencies. Failure to reach the normal vasodilatation level under the simple conditions of the covered period indicates the presence of organic vascular occlusion.

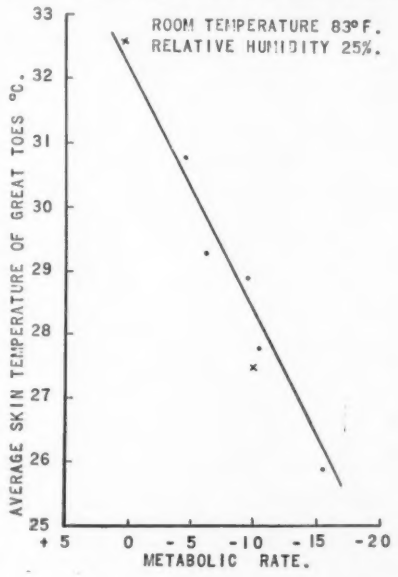

FIG. 5.—The relationship of the average skin temperature of the great toes to the metabolic rate, for the subjects of Fig. 4 and Fig. 6.

The Surface Temperature Response to Increased Heat Production.—The existence of some variation in the basal metabolic rate of normal individuals is well established. To show the influence of these variations on surface temperature, a group of normal subjects with different basal metabolic rates was studied under constant environmental conditions. Their skin temperatures at the time of determining their basal metabolic rates are shown in Fig. 4. The general increases in surface temperature, starting with the subject of lowest heat production, is simply the result of each one of them having more heat to dissipate, as shown by the increases in basal metabolic rates. The major shift of blood to the extremities in the adjustment is well demonstrated, the increases in skin temperature being much greater there than on the head and trunk.

At a rough glance, the increases in the temperatures of the toes of the subjects of Fig. 4 appear to be somewhat proportional to the increases in the heat production. The exact connection between these two factors is brought out in Fig. 5 where the average skin temperature of the great toes is plotted by dotted points against the basal metabolic rates. A simple linear relationship is seen to exist. This shows that the degree of vasoconstriction of skin vessels present in the great toes of the subjects of this study was not the result of many complicated factors but simply related in an orderly fashion to the process of heat dissipation.

Many activities during a day alter the metabolic rate with a consequent alteration

* Following the publication of this article, it was learned that a somewhat similar method of releasing peripheral vasoconstriction had been presented by Lewis and Pickering: Heart, vol. 16, p. 33, 1931–1932. Inadvertently, this reference was omitted from our publication.

in the heat dissipating adjustment. A simple example of the effect on the surface temperature of a normal increase in metabolic rate is shown by subject K. M. in Fig 6. The study was carried out under the same environmental conditions as of the group in Fig. 4. The heat production of 35.6 C/M2/Hr on January 18, 1933, was obtained entirely under basal conditions while the increase to 39.6 C/M2/Hr on February 16, 1933, was due to the specific dynamic effect of a high protein meal eaten two hours before the study. The same points of interest are present that were shown by the group in Fig. 4. The following calculation of the skin temperature increase at various body points as a result of the increased heat production serves to emphasize by figures the predominance of the shift of blood to the extremities:

Increase in skin temperature of trunk point No. 5 = 0.6° C., or 1.8 per cent.
Increase in average skin temperature of thumbs = 1.3° C., or 4.0 per cent.
Increase in average skin temperature of great toes = 5.1° C., or 18.7 per cent.

The relationship of the average skin temperature of the great toes to the metabolic rate for this subject is shown in Fig. 5 by the cross points. The temperatures fall

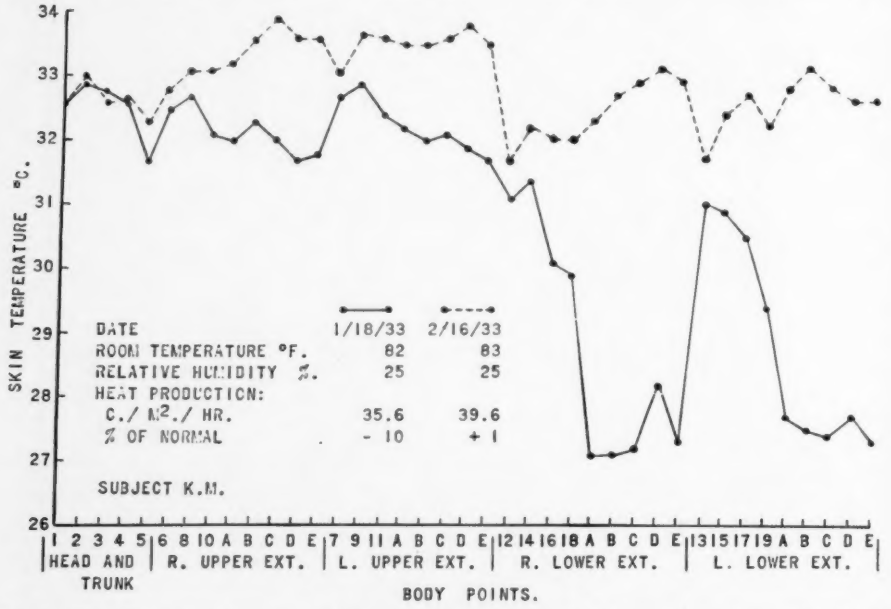

FIG. 6.—The effect of an increase in heat production on the surface temperature of a single subject, the environmental conditions being constant.

along the same line as that of the group in Fig. 4. The simplicity and orderliness of the process under the conditions of the study is quite apparent.

The Temperature of the Skin Under Constant Heat Production and Environmental Conditions.—The data for Fig. 2 and Fig. 6 were obtained from subject K. M. and showed his surface temperature response to first an increase in environmental conditions and later to an increase in heat production. In Fig. 7 is shown his surface temperature at two widely different time periods but under similar conditions of environmental temperature and humidity and heat production. The skin temperatures are practically the same. This result is to be expected when one considers the importance of these factors to heat dissipation.

Comment.—The important part played by the extremities in the dissipation of body heat is not generally recognized. The regulation against over-

heating is accepted as a vasomotor shift of blood to the surface of the body which favors an increased loss of heat by both radiation and evaporation, the latter process being aided at higher environmental temperature, by the sweating mechanism. It is only by a study of the skin-temperature response of the whole body surface that the inequality of the shift of blood to or from the different parts of the body surface becomes apparent and the greater importance of the extremities in the variations of heat dissipation is fully appreciated. The more marked and varying degree of vasoconstriction found in the extremities over that of the remainder of the body surface is simply the result of their more important heat-dissipating function.

These observations agree with an investigation of the insensible vaporization of water by Loewy,[8] who reports that per square metre of body surface this heat-dissipating process is greatest in the arms, next greatest in the legs

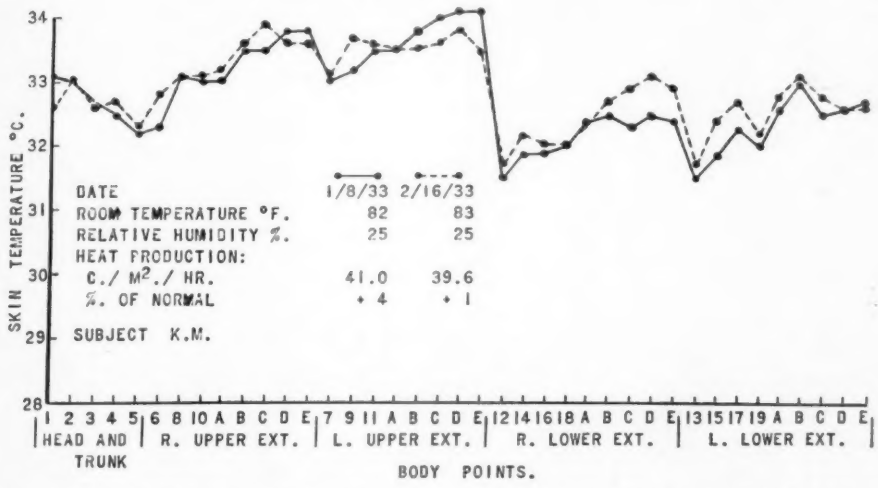

FIG. 7.—The similarity of the surface temperature of a subject at two different periods when the environmental conditions and the heat production were the same.

and least from the trunk. Considering parts alone, the extremities yielded not far from 75 per cent. of the total, the greatest actual loss occurring from the legs.

It is entirely fitting that the extremities should have several characteristics suitable to their important heat-dissipating function. Measurements of the surface area of the body show that the extremities have approximately 65 per cent. of the total, the head 10 per cent., and the trunk 25 per cent.[9] A major shift of blood to the extremities is therefore to an area sufficiently large to care for wide normal variations. Again, the vital structures of the body are situated within the trunk and head. It is a characteristic of warm-blooded animals to maintain these parts at a comparatively constant temperature with the production of serious physiological disturbances in case of material variations from the constant. The extremities, on the other hand, are thrust out into the environment in such a way as to promote the dissipation of heat and

also are able to function satisfactorily with wide variations in the temperature of their component tissues.

In the study of patients with peripheral vascular diseases the influence of environmental temperature on surface temperature has been recognized and considered. In order to make comparisons between the skin temperatures obtained, the studies are generally carried out under a standard room temperature. This investigation shows the important influence of heat production on surface temperature. It is impractical to determine routinely this factor at the time of skin-temperature studies, but without it comparisons between individuals are of little value.

A transfer of the concept of the heat-dissipating function of the extremities to cases of peripheral vascular deficiency is of particular interest to us. By the use of test procedures, these patients have been separated into three main groups with the following stated characteristics:

(1) Organic occlusion alone, no or very slight spasm. This group includes the majority of patients with peripheral arteriosclerosis, senile or diabetic, and far-advanced thrombo-angiitis obliterans.

(2) No organic obstruction, pure spasm. The best examples are Raynaud's disease and vascular spasms associated with other conditions, such as anterior poliomyelitis.

(3) Some organic occlusion and a variable degree of "superimposed spasm." Early and moderately advanced cases of thrombo-angiitis obliterans and early arteriosclerosis fall into this class.

The heat-dissipating process should occur in these individuals as in normals with of course some limitation through the inability of their extremity vessels to completely dilate or contract. In many instances it is then difficult to evaluate the factor of simple vasoconstriction in relation to the heat-dissipating mechanism against that of "superimposed vasospasm." Vasospasm does not occur and is best detected by direct observation. It is clearly seen when the chief symptom is that of blanching of the digits on exposure to cold. The most definite examples are in the group of diseases in which no organic occlusion is present, the disturbance being fundamentally vasomotor in type.

In the organic type of peripheral vascular disease the primary pathology is the occlusive arteritis. The earlier this process the greater the degree of vasoconstriction that can be demonstrated. This is logical because the less extensive is the disease process the more nearly normal will be the heat-dissipating mechanism with a consequent normal degree of peripheral vaso-constriction. Pickering[10] recently mentioned the common error of interpreting all peripheral vasoconstriction as a pathological process. In thrombo-angiitis obliterans in particular, the so-called "superimposed vasospasm" has been given considerable attention and is generally considered to be the result of irritation of the perivascular nerve fibres by the inflammatory reaction of the occlusive process. Some of this "vasospasm" is normal vasoconstriction, just how much can be determined only by studies of the periph-

eral vasoconstriction of those patients in relation to environmental conditions and heat production and by subsequent comparison with normals. Silbert and Friedlander[11] reported the basal metabolic rate of patients with thromboangiitis obliterans to be unusually low. This factor can be responsible for a considerable part of the abnormally low peripheral skin temperatures found in these patients.

Beginning with the work of Hunter and Royle[12, 13] it has gradually been recognized that the circulation of an extremity can be markedly improved by a sympathetic ganglionectomy. We consider this improvement to be brought about simply by an interruption of the heat-dissipating function of the extremities, so that varying degrees of vasoconstriction in response to this mechanism no longer occur. In this regard it is significant that sweating is also stopped by the operative procedure. The parts thrown out of function by the usual operative interruption of the sympathetic chain are the hands, the legs, and the feet. The hands and feet generally show the greatest increase in circulation. Individuals on whom lumbar and cervicodorsal ganglionectomy have been done are apparently not inconvenienced by the loss of this function. However, as Lehman[14] and DeTakats and MacKenzie[15] have recently emphasized, there is so little evidence in many instances that the vasomotor system in itself is primarily at fault, in even the functional type of peripheral arterial disease, that all the factors involved and other methods of treatment should be carefully considered before carrying out major operative procedures on the sympathetic nervous system.

Conclusions.—(1) Studies of the skin-temperature response to changes in environmental conditions and heat production show that the surface of the extremities has a much greater function in the dissipation of body heat than does the surface of the head and trunk.

(2) The heat-dissipating function of the extremities is the important process responsible for the normal presence and degree of peripheral vasoconstriction.

(3) The functioning of this normal process in the extremities of individuals with peripheral vascular deficiencies is probably responsible for a considerable degree of the so-called "vasospastic element."

(4) Sympathetic ganglionectomies increase the blood flow to the extremities by interrupting their normal heat-dissipating function.

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PRIMARY CARCINOMA OF THE BARTHOLIN GLAND

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Primary carcinoma of the Bartholin gland is extremely rare. Rabinovitch[5] (1932) stated that the total number of cases was not more than forty. Harer[3] (1933), in his review of the world's literature, found only thirty cases and stated that several of these were doubtful. Since Harer's[3] article, two cases have been reported by Strauss,[7] in Brooklyn. Dr. W. P. Healy[4] has kindly allowed me to report three cases of recurrent adeno-carcinoma of Bartholin's gland, all of which had been previously operated upon by others for supposedly benign lesions of Bartholin's gland. The pathological diagnosis of these cases were made by Dr. James Ewing.[1] All these cases are alive and well; one four years; two over five years. These latter, with the one case reported by the author, bring the total to thirty-six; eleven of these have been reported from America.

An early diagnosis is seldom made because of the rarity of the condition, but if the possibility of the disease is kept in mind the diagnosis is comparatively simple. Rabinovitch[5] says that the correct early diagnosis of malignant tumors of the Bartholin gland is made less frequently than of malignant tumors involving any other organ of the body. Yet carcinoma arising from the Bartholin gland possesses a distinct and characteristic pathological structure which can be readily recognized and differentiated from tumors arising from other glandular organs.

Etiology and Morbid Anatomy.—The study of the reported cases yields no definite etiological factor. Trauma and Neisserian infection do not seem to play any part.

Pathology.—The normal Bartholin gland is composed of acinous structure in which the acini are lined with columnar or cuboid cells and the ducts with squamous cells, consequently we find two types of carcinoma with columnar and squamous cells. If the normal transitional epithelium lining the deeper portions of the ducts is replaced by squamous epithelium as the result of chronic inflammation, a squamous carcinoma can arise from the deeper parts of the ducts. Rabinovitch,[5] in commenting on the pathological findings, calls attention to the striking similarity of the tumor to malignant thyroid tissue.

Clinical Features.—In the early cases the first sign reported by the patient has been an accidental discovery of a hard, slightly nodular, painless movable lump in the posterior half of the labium majora. Within a relatively short time the mass increases in size, becomes fixed and tender. At this stage the infiltration of the surrounding tissues may produce a troublesome œdema of the vulva or the growth may break through the mucous membrane and appear as one or more nodules or ulcers. Depending on the origin of the growth

the tumor takes on squamous or papillary characteristics. At this stage it is often difficult to make a clinical differentiation between a carcinoma of Bartholin's gland and an epithelioma of the vulva. The glandular involvement varies considerably in the reported cases but the general impression obtained from the later reported cases seems to indicate a moderately early involvement of the glands, but in the cases that have been accidentally discovered the involvement does not appear to be so rapid.

Age.—The youngest reported case is twenty-eight years, the oldest ninety-one years; the majority of the reported cases have been over fifty years of age.

Case Report.—Patient, Mrs. M., referred to Doctor Lyle's service at St. Luke's Hospital by Dr. H. M. Moretsky in January, 1932, with the history that a little more than a year and a half before her admittance she noticed a small, hard, painless lump about the size of a pea on the right labium majora. She paid little or no attention to this until quite recently when she noticed that it was beginning to enlarge and at times was painful. There was no bleeding or discharge, nor was there any history or evidence of infection. The increase in pain and size led her to consult her family physician, who, after observing it a short time, advised her to enter the hospital.

The patient is a thirty-year-old multipara in good physical condition. In the right labium majora there is a small, hard, irregular ovoid mass, the longest diameter being about three centimetres. The mass is movable and occupies the site of the Bartholin gland. The overlying mucous membrane is not involved. A diagnosis of a fibroma or calcification of Bartholin's gland was made. As the patient objected to a general anæsthetic the growth was removed under novocaine. The true nature of the condition was not realized until the pathological diagnosis of adeno-carcinoma of Bartholin's gland was received. On account of the great reluctance of the patient to have any further operation, she was placed under observation. She was seen some three months later and there was no sign of recurrence; five months later a small recurrence appeared at the site of the first operation. After a great deal of persuasion on the part of the family physician the patient consented to a second operation.

Operation, July 7, 1932. Endothermic vulvectomy for recurrent adeno-carcinoma of the right Bartholin gland. Under gas-oxygen anæsthesia an outlining incision was started two centimetres below the urethra and carried downward along the vaginal canal to the perineal and sphincter muscles, then upward parallel but five centimetres external to the vulva. The area within the outlining incision was removed *en bloc*, exposing the underlying muscles and the periosteum of the inferior ramus of the pubis. The resulting gap was closed by plastic reconstruction. A thorough post-operative course of radiation, both regional and local, was given. The patient is well and free from recurrence at the present time.

First pathological report by Dr. L. C. Knox was that macroscopically the specimen consists of a tumor from the right Bartholin gland, the tumor measures three centimetres in diameter and is shaggy externally, showing no signs of encapsulation. On section the cut surface is firm, white, opaque in color, and homogeneous in consistency. *Microscopical examination* of the tumor shows no normal structures, except a very little striated muscle along one surface. In close contact with this is a large nodule which occupies most of the section, composed of an epithelial tumor in which there is a marked tendency toward formation of glands. They are all small but many are almost complete. The epithelium, however, infiltrates in many areas without forming glands, and therefore the tumor is a carcinoma and is definitely malignant. The epithelial cells are rather small and do not appear to be producing mucus but the growth is from the columnar surface rather than from the cutaneous epithelium.

Second pathological report by Dr. L. C. Knox. *Diagnosis.*—Recurrent adenocarcinoma of Bartholin's gland. *Macroscopical examination.*—Specimen consists of tissues from the vulva measuring five times four times three centimetres. There is a small oval fragment of skin three centimetres in length to which is attached a mass of subcutaneous tissue and fat. On section beneath the skin there is a firm, spherical mass, dense, opaque white, which is adherent to the skin. *Microscopical Examination.*—Section of the tissue shows there is throughout a widespread infiltration with a glandular type of carcinoma. This is in the form of a small acini, many of which are fairly complete although there are large areas in which only portions of the glands or single cells may be seen. They are assembled in a rather hyaline and extensive fibroid stroma, giving the structure a very firm, carcinomatous growth. The nuclei tend to be small and the cytoplasm is clear in some areas, and granular in others. This resembles in many respects the tumor formerly excised.

Conclusions.—Carcinoma of the Bartholin gland is as malignant as epithelioma of the vulva and unfortunately is also radio resistant. Our study leads us to believe that the primary operation should consist of a wide excision of the vulva plus a secondary dissection of the inguinal and femoral glands, the excision to be carried out with the cold scalpel or the endothermic knife. In the advanced cases it is advantageous to destroy the original growth with endothermic coagulation and then proceed immediately with the above operation. The operation should be followed by a thorough local and regional radiation. Healy,[4] in his cases, applied radon seeds to the recurrence and later did a radical excision of the vulva glands. The success of any method rests on an early diagnosis; this diagnosis is not hard to make if the condition is kept in mind.

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FRACTURES OF THE SKULL

A REVIEW AND SUMMARY OF 30 YEARS EXPERIENCE

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and
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For the past thirty years the senior author has directed the study of all cases of acute cerebral injury that have entered the wards of Harlem Hospital, and has personally studied most of those treated during this time period. All of the cases were under the personal supervision of the senior author for twenty-five years, and since that time they have been observed by one of the two authors or both. Some of the cases included in this report have been the subject of previous communications.[1, 2, 3] It was thought that a rather large group of cases studied and treated by one observer continuously over a long period of years in one institution would prove of interest to workers in this field of traumatic surgery. The material on which this paper is based consists of 1,760 cases of cranial and intracranial injuries. It was impossible to include the cases that were treated during part of 1927, 1928, 1929, and up to and including part of 1930, due to a breakdown of our hospital record room administration, which we deeply regret.

We divided the cases into three groups, as shown in Table I.

Table I

	Number of Cases	Lived	Died	Mortality Per Cent.
First series, 1914–1924, operative period.....	497	239	258	52.1
Second series, 1925–1927, conservative period..	336	182	154	45.0
Third series, 1930–1934, conservative period...	927	724	202	21.7
Totals.....	1,760	1,145	614	34.3

In October, 1931, we felt that if we should study a group of cases in which we proved the presence of a fracture of the skull, and a group of cases in which we proved the existence of intracranial injury without fractured skull, that our work would be of more value than it would be if these cases were considered simply instances of "head injuries," or so-called "clinical skull fractures," which in the past had involved much guesswork to a greater or lesser extent on the part of all of us. To that end we established the following diagnostic criteria, as indicated, to wit:

(1) Proved skull fracture
  (*a*) X-ray demonstration of fractured skull.
  (*b*) Visualization of fracture as is possible in certain compound fractures, or at operation.

(2) Proved intracranial injury without skull fracture
  (a) Presence of red blood-cells in the spinal fluid with X-ray of skull negative for fracture.

Fortunately, post-mortem examinations of many of the fatal cases were made at the hospital by our pathologist or by a member of the medical examiner's staff and we were able to see the pathological lesions ourselves; while in the remaining fatal cases an autopsy was done on the majority of them after the body had been removed to the city morgue by a member of the medical examiner's staff. The medical examiner's office has been kind enough to supply us with copy of their protocol. All cases, in which there was a discrepancy between the clinical and pathological diagnosis, were finally classified according to the pathological diagnosis. This is illustrated in Table II.

TABLE II

Period from October 1, 1931, to May 1, 1934	Number of Cases	Lived	Died	Mortality Per Cent.
Proved skull fractures (X-ray, inspection, autopsy)	490	354	136	28.08
Proved intracranial injury (red blood-cells in spinal fluid)	308	271	36	11.6
Totals	798	625	172	20.03

All cases admitted to the hospital with a history of unconsciousness following trauma to the head but which did not fulfill the above requirements were excluded from this study; thus many cases of "cerebral concussion," as so ably described by Trotter[4] clinically, were eliminated. It is of interest to note that we have seen at post-mortem only one instance of death due to cerebral trauma that did not show gross evidence of brain pathology, while Vance[5] lists 139 cases in his autopsy series as instances of death due to cerebral concussion; and the wide difference between Vance's observations and ours may be in part explained by Miller's[6] view that death from cerebral concussion is immediate. If this is true, the serious cases do not reach the hospital alive and the cases that do reach the hospital are not of such immediate and urgent clinical importance. Those that we see are exceptionally mild as regards symptomatology and clinical course. We are satisfied that as our clinical and pathological methods improve that our management of these cases of so-called "concussion" may be greatly enhanced. Perhaps in some of these non-fatal cerebral concussion cases there were some that had multiple petechial hæmorrhages as first described by Cassasa[7] which forms also in the opinion of Martland[8] the pathological basis of "punch-drunk."

We thought that a brief analysis of a few of the published clinical reports, in which a relatively large group of cases were studied, might help us understand better some of our present problems; and it serves to emphasize the pressing need of some standard diagnostic classification upon which

we could all agree. In the latter connection Table III is especially illuminating.

TABLE III

	Total Number of Cases	Number of Cases from Which Mortality Was Calculated	Mortality Per Cent.
McCreery and Berry	520	520	39.0
Coleman	596	453	18.5
Gurdjian	718	718	19.0
Kennedy and Wortis	1,000	1,000	37.8
Munro	1,494	989	17.8
Connors and Wright (Proved cases only)	798	798	20.3

These case reports were made within the last six years. The apparently high mortality of McCreery and Berry,[9] and Kennedy and Wortis[10] is explained by the fact that they used roughly the same diagnostic criteria, as the two groups of cases which were studied at Bellevue Hospital. Our diagnostic requirements were exactly the same as those used by Kennedy and Wortis. Coleman[11] bases his diagnosis on demonstrable fracture or unconsciousness, or both. Gurdjian[12] proved that 475 of his patients had a fractured skull and used the history and clinical signs in the remainder of his cases. Munro[13] makes use of the X-ray, but apparently depends on the ability of his staff to recognize clinically: (1) œdema and congestion; (2) contusion; (3) laceration of the brain. This it is impossible to do with exactitude, in our opinion. The studies of Beekman[14] and Ireland[15] have shown that the mortality in childhood and young adolescence is materially lower than that in adults. This is important in the event a given series of cases contains the case histories of many children or persons eighteen years of age or younger, because the age factor alone would automatically lower the mortality. There were 103 cases of histories of persons eighteen years of age or younger in our group of proved cases; eleven of these died, giving a mortality of 10.6 per cent. The foregoing makes it clear that it is impossible to judge accurately the merits of the different method of treatment used in our larger clinics due to a lack of standardization of diagnostic requirements. This should be corrected if our published records are to possess the value that they should, in the way of affording a basis for comparative study.

Our study of the pathology present in these acute cases of craniocerebral injury has not revealed to us a single instance of traumatic cerebral œdema of a generalized nature coming on within forty-eight hours after injury, and this is significant because most of the fatal cases die during this time interval. We have studied many specimens over a period of years with this idea in our minds, and so we categorically deny the early occurrence of cerebral œdema. We are also somewhat skeptical of its late occurrence as we have never seen it. We do not doubt that it has been occasionally observed at autopsy in some cases of cerebral injury, but we can only explain it on the grounds that the brain was œdematous from some other pathological condi-

tion before the injury. LeCount and Apfelbach[16] introduced the term "traumatic œdema," and later Apfelbach[17] described it as "a generalized œdema." Vance never observed a case of death that he felt was due to cerebral œdema, and the cases in which he found it were two to five days after injury. In those cases it was localized to an area adjacent to the laceration of the brain. We have never observed an increase in the amount of circulating spinal fluid as depicted by Rand and Courville,[18] and the same has been our experience as regards the abnormal collections of spinal fluid which Naffziger[19] observed. It is our opinion that these pathological changes are not characteristic of cerebral injury *per se*. We have observed enough hæmorrhage and brain laceration in practically all fatal cases to adequately explain the clinical signs and symptoms noted during life, and the cause of death.

Rupture of a cerebral artery or a laceration of one of the venous sinuses has been the cause of death in the majority of our cases, and intradural hæmorrhage was present as evidence of the apparent exodous producing factor. Pontine hæmorrhage is a rare exception. This leads us to believe that subarachnoid hæmorrhage, which is the usual non-fatal variety of hæmorrhage, is due to lacerations of veins and capillaries; and, since intracranial pressure is almost the same as venous pressure, it is easy to see why such hæmorrhage tends to subside spontaneously. We observed one case of extradural hæmorrhage which bled intradurally through a tear in the dura caused by an inbending of the temporal bone at the time of injury.

We have, for the sake of convenience, made up a chart of the diagnostic signs and symptoms of acute brain injuries, as seen in Table IV.

TABLE IV

ACUTE CRANIOCEREBRAL INJURY DIAGNOSIS

Positive signs, any one is absolute.	(1) X-ray positive for skull fracture. Pneumocephalus. (2) Direct visualization of fracture: Compound fractures, at operation, at autopsy. (3) Escape of spinal fluid from nose or ear.
Probable signs.	(1) Blood in cerebrospinal fluid. (2) Bleeding from ear or ears.
Presumptive signs and symptoms.	(1) History of trauma to head. (2) Unconscious or history of unconsciousness. (3) Paralysis of cranial nerves, monoplegias, hemiplegia or paraplegia. (4) Convulsions. (5) Abnormal reflexes. (6) Traumatic delirium. (7) Urinary incontinence. (8) Eye signs. (9) Glycosuria and hyperglycæmia. (10) Scalp lacerations or hæmatomas, and ecchymosis of eyelids.

Rule out alcoholism, drug poisoning, syphilis, diabetes, uræmia, cerebral hæmorrhage, embolism, neoplasm, chronic subdural hæmatoma, and spontaneous subarachnoid hæmorrhage in differential diagnosis.

The following routine procedures have been adopted by us in making a diagnosis, namely;

(1) A careful history, if obtainable.

(2) X-ray of patient upon admission unless in shock.

(3) Immediate examination of patient by member of visiting staff, irrespective of hour of day or night, if unconscious or apparently serious in any way. Careful head inspection may reveal a compound fracture, and an inconspicuous scalp hæmatoma may aid in localizing a contre-coup laceration.

(4) Spinal tap at once and a cell count of the cells in the spinal fluid. Red cells in spinal fluid with negative X-ray makes a tentative diagnosis of intracranial injury without skull fracture. When X-ray is positive the number of red cells in the spinal fluid gives a fair index of degree of subarachnoid hæmorrhage.

(5) Second spinal tap and cell count of cells in spinal fluid to be made eight to twenty-four hours after initial tap. If good stereoscopical X-ray plates are negative and the two spinal fluid specimens are devoid of red cells, in the absence of other evidence the patient is not considered to be a case of acute craniocerebral injury.

(6) Study patient for the development of presumptive signs or symptoms.

(7) Readings of cerebrospinal-fluid pressure are made, but they are not of much diagnostic importance. Primary hypotension of spinal fluid makes prognosis grave in proved injury cases.

(8) White blood count and urinalysis on all cases. A complete blood-chemistry study and especially blood-sugar determinations on all unconscious patients. Blood and spinal-fluid Wassermann tests on all admissions.

(9) A careful examination for associated injuries.

(10) Neurological and ophthalmological examination of all patients.

It is impossible, for us to agree with Dandy,[20, 21] and Sachs,[22] when they object to diagnostic lumbar puncture in these cases, on the grounds that it is too dangerous for the patient; and Dandy goes so far as to say that almost nothing of value in diagnosis is gained. We grant that the measurement of the spinal-fluid pressure for the first few days is relatively unimportant, but the number of red blood-cells in the spinal fluid has been our most important index of the degree of cerebral injury in most of our cases. And at present it is the surest way of diagnosing subarachnoid hæmorrhage, cases exhibiting combined extradural and subdural hæmorrhage, and is of tremendous value in aiding in the diagnosis of epidural hæmorrhage, of the uncomplicated variety. The same applies to those unusual cases of intramedullary hæmorrhage with marked clinical signs; the diagnosis of this lesion is based on the fact that the fracture line, if present, is away from the cranial grooves of the middle meningeal arteries, and there is a very low count of the red cells in the spinal fluid, entirely disproportionate to the clinical signs and symptoms.

Many cases come into hospitals unconscious from alcohol, some with and some without a history of trauma and about an equal number or more have no cerebral injury, but it is suspected; and, without spinal taps to find out whether there are red cells in the spinal fluid, one cannot make a diagnosis for or against intracranial injury. Munro reports over 1,000 lumbar punctures with no deaths attributable to the procedure. In over 2,000 spinal taps, we have had no deaths that we thought were due to the puncture. It is our belief that lumbar puncture is a relatively harmless procedure, when carefully and intelligently done for purposes of diagnosis. This is not to be taken to mean that there is not a slight element of danger present, and that in a very rare instance harm may not accrue to the patient, but altogether the preponderance of evidence, and our experience substantiates our conviction, that skillful routine spinal punctures are essential aids to accurate diagnosis, and are of indisputable benefit to the proper handling of these cases. These considerations greatly outweigh any slight or potential harm that may or may not be done in very exceptional instances.

Four years ago we began to make routine red-cell counts of the spinal fluid specimens obtained by lumbar puncture, as it seemed to us more desirable to actually count the red blood-corpuscles in the specimen and record our findings in terms of the exact erythrocyte count. At first we made only one spinal tap routinely and counted the red cells in the one specimen, but as the work progressed we discovered that two erythrocyte counts at properly spaced intervals yielded much more definite information as regards the case, so we adopted the double red-cell count as a routine procedure. The interval between the counts was as a rule never less than eight hours nor over twenty-four hours. We have carried out red-cell counts on over 500 cases and found in general the higher the red-cell count the more serious the injury. In many instances where we obtained an initial low red-cell count, and one which did not seem to parallel the clinical condition of the patient, the second count was invariably much higher. Low initial counts may be caused by shock, and in many instances the injury has interfered with the circulation of the spinal fluid and there is a lessened diffusion of the cells. In cases of pure extradural hæmorrhage and pure intramedullary hæmorrhage, the red-cell count is persistently low, averaging 1,000 red cells or less.

Queckenstedt tests were carried out on over 500 patients, and in not a single one was there any evidence of any subarachnoid block, even in cases where the spinal fluid seemed to be pure blood; so we discontinued further studies along this line, although it was thought we might find some evidence of block in a few fractures in or about the occipital bone.

Most patients that were conscious upon their arrival on the wards recovered, and the majority of patients that regained consciousness shortly after they were admitted got well. We agree with Dandy when he states that a deepening coma is undeniable evidence that the patient is getting worse. Acute alcoholism has been present in over one-half of our admis-

sions, and because of this it has made the early diagnosis of unconsciousness due to cerebral injury extremely difficult.

Urinary incontinence in a non-alcoholic patient on admission is a sign of serious brain injury, and its late appearance is of grave prognostic significance. It is an important sign in an alcoholic patient after the effects of the alcohol have worn off. We have never seen a single instance of incontinence of fæces as noticed by Dandy in some of his cases.

The essentials of good treatment consists of:

(1) Gentle handling of these patients on the part of instructed ambulance surgeons, while they are transporting these cases to the hospital.

(2) Rest in bed with good nursing. Special nurses on all cases that can afford them.

(3) Treatment of shock, if present. Management of associated injuries with intelligence.

(4) No operations in most cases.

(5) Operate only on:

(*a*) Extradural hæmorrhage or suspected epidural hæmorrhage.

(*b*) Certain compound fractures.

(*c*) Some depressed fractures.

(*d*) Frontal sinus fractures, only where dura is torn.

(*e*) Subacute subdural hæmatoma, only after seven days.

(6) Keep patient warm at all times. Warmth not only combats shock but helps to prevent pneumonia. Most of our cases that lived forty-eight hours after the injury, then died; an aspiration or hypostatic pneumonia was the cause of death. In late fall, winter and early spring pneumonia jackets should be put on all patients to prevent chilling, which chilling seems to hasten the onset of pneumonia.

(7) Keep mouth and throat clear of blood and mucus by suction, and properly care for bleeding ears so as to prevent infection.

(8) Put bed in Fowler's position, and attach side-boards if the patient is unconscious.

(9) Ice-bag to head.

(10) Maintain fluid balance if patient is dehydrated by means of a duodenal tube or Murphy drip if patient is unconscious. Hypodermoclysis if necessary.

(11) Nourish unconscious patients by means of duodenal tube feedings and nutritive enemata. Also the juice of three oranges daily if patient is stuporous.

(12) No intravenous glucose, dehydration, lumbar drainage, or magnesium sulphate solutions per rectum during first few days.

(13) No morphia or avertin to control traumatic delirium. Morphine is a depressant to respiration and the effects of avertin are too prolonged. May judiciously use amytal or luminal for sedation, if case is of the non-operative type.

(14) May use "delayed hypertonic glucose solutions with insulin," or

"delayed lumbar drainage," after six days in carefully selected cases that are not doing well clinically and which exhibit a persistently high intracranial pressure; and then only if you do not think further hæmorrhage will be provoked.

The purpose of this plan of management is to: (*a*) give the brain a chance to stabilize itself without producing more hæmorrhage; (*b*) maintain fluid balance; (*c*) keep up nourishment and prevent starvation acidosis; (*d*) and prevent pneumonia and meningitis.

The high mortality shown in the first two series of cases in Table I is the best evidence of how much real value there is to subtemporal decompression operations in the majority of instances. We are forced to disagree with Dandy's recommendation of subtemporal decompression operations in 10 per cent. of the cases of subdural hæmorrhage. The vast majority of cases that survive operation would live without it. Injections of hypertonic glucose solutions, lumbar drainage and subtemporal decompression operations all aim at the same thing, namely; a relief of intracranial pressure, but each in a different way. It is true that a subtemporal decompression operation may effect a much greater relief of pressure, but at best it is only the treatment of a symptom. Certainly it cannot cure brain laceration, and subarachnoid hæmorrhage cannot be controlled by it excepting in very few instances; while in most cases it provokes and provides room for much more hæmorrhage that as yet cannot be controlled safely by any means known to us. In one case we were fortunate in being able to stop a hæmorrhage from a cortical vein by means of the Bovie machine coagulating current. We are firmly opposed to early operations for the relief of intracranial pressure *per se*; as we feel that many lives will be lost unnecessarily.

Our objections to the routine use of injections of hypertonic solutions of glucose are based on the fact that we believe that the cases that live after glucose injections would live without them, and that in our hands it has been a death-producing agent in far too many instances. It exercises a damaged brain. The work of Weed[23] and his colleagues has shown that hypertonic solutions will cause a shrinkage of brain volume, and this we have confirmed at operation, while the experimental work of Milles and Hurwitz[24] has demonstrated that this early fall in intracranial pressure is followed by later rise in intracranial pressure, and that the secondary late rise in pressure is always higher than the initial pressure. Jackson, Leader and Kutsunai[25] proved the secondary rise in intraspinal pressure in twenty clinical cases, and we obtained similar results in six patients. We made no further observations, as we were satisfied as to the correctness of the observations of these workers. Clinical observation on our part has caused us to discontinue its routine use long before the work of Milles and Hurwitz, and Jackson, Leader and Kutsunai had appeared. Pathologically, this early use of glucose allows more space for bleeding as a result of its reduction of brain volume and consequently a larger compressing mass is produced; and its repeated use permits this mass to grow larger and larger. Browder's[26]

case is a classical example of death hastened from subarachnoid hæmorrhage by injections of hypertonic glucose solutions. Jefferson[27] puts it well when he says: "if the whole picture of the post-traumatic state were due to a compression relievable by hypertonic solutions, the part played by what we term 'physiological decompression' by hypertonic solutions would at this date be so universally accepted that we should not need to inquire into its usefulness." If one insists on using glucose solution injections, insulin should be given at the same time so as to burn up the glucose in the tissues, and in this way the glucose is prevented from being taken up by the nervous-system tissues and there act as an agent increasing osmotic flow towards and into the central nervous system parenchyma.

In carefully selected cases, and they are rare, we have used "delayed glucose injections with insulin." We have used it apparently with good results to the patient in eleven instances. It should never be used before the sixth day following injury, and then only if it is thought that all hæmorrhage ceased. A spinal tap should also show that there is an increase of intracranial pressure. We have arbitrarily decided that the intraspinal pressure should be at least 180 millimetres of water (Ayer manometer) or above. We have used it in conjunction with what we call "delayed lumbar drainage." If on the sixth day or later a case is not doing well clinically, and on spinal tap the spinal fluid is clear and shows an increase in spinal-fluid pressure, we drain off spinal fluid until the pressure registers on the manometer one-half of the initial pressure, but under no circumstances is the pressure drained so that the manometer registers less than ninety millimetres of water. The dangers of the use of "delayed intravenous injections of glucose with insulin" combined with "delayed lumbar drainage" are illustrated by the case of a male patient who regained consciousness about three hours after he was admitted to the ward, and who for four days was doing well, and on the beginning of the fifth day one of the internes, by mistake, did a "delayed spinal drainage," although his spinal pressure was only 130 millimetres of water, and also administered "delayed intravenous glucose with insulin." The patient went steadily downhill and died twenty hours later. At autopsy a moderate laceration of the right frontal lobe was found, and around the laceration was a very dark blood-clot that was organizing, while from one part of the laceration and in the subarachnoid space was much fresh bright red blood, which demonstrated clearly that the original hæmorrhage had been checked and that a secondary hæmorrhage had been provoked.

Jackson,[28] Fay,[29] Kennedy and Wortis, Munro and many other excellent observers advise early lumbar drainage in cases of acute craniocerebral trauma. Bagley[30] states that blood *per se*, in the subarachnoid space, produces important clinical symptoms, and many observers on the basis of his work have advocated spinal drainage, while Wortis and McCollugh[31] report that blood in the subarachnoid space rendered the brains of dogs more sensitive to stimulation. Our observations on human beings have failed absolutely to confirm the findings of either Bagley or Wortis and McCollugh,

and, therefore, we do not feel that their findings should be relied upon in any effort to justify the therapeutic use of spinal drainage. Drainage of spinal fluid in these cases produces more bleeding in the great majority of cases and is, therefore, distinctly harmful.

Jefferson cites three immediate fatalities following the use of lumbar puncture for therapeutic purposes. Drainage interferes with the cerebral "tamponade," which is the most effective mechanism for controlling subarachnoid hæmorrhage, and fewer of the cerebral regulatory mechanisms have a chance to function than if there was not the added upset of pressure relations. The temporary lowering of intraspinal pressure causes more bleeding and the pressure soon returns to its original height, and subsequent taps only give the blood-clot a chance to grow larger and larger, and in many instances to the place where the brain cannot withstand the increased pressure of the blood mass and death ensues.

We have seen a marked clinical improvement follow lumbar drainage in an occasional patient, and that was in patients in whom no further bleeding was produced. But it is not possible to differentiate the occasional case in which no further bleeding will be provoked from the others, which form the great bulk of cases, and for this reason we strongly advise against its routine use. It has seemed to us that many surgeons have used it on cases that were getting progressively worse, and they were actuated largely by a desire to do something that might help. Lumbar drainage when combined with glucose injections or used alone is not only immediately dangerous but could adequately explain many of the bad late end-results that are seen all too frequently.

We have made encephalograms on over 100 of these cases that returned to our follow-up clinic and in only nine instances have we found any abnormality, such as: cortical atrophy; distortion or dilatation of the ventricles —that is, so far as we were able to determine. It is too early for us to draw conclusions from our encephalographical studies.

Conclusions.—(1) There is a great need for the establishment of definite and accurate diagnostic criteria for the study of end-results of acute cerebral-injury cases.

(2) Maximum clinical study should be used not alone but conjointly with all other methods of study if we are to save more patients' lives.

(3) Careful and intelligent lumbar puncture for diagnostic purposes is a relatively harmless procedure and its routine use is advocated.

(4) Red-cell count of the spinal fluid is a valuable aid in diagnosis and in prognosis.

(5) The treatment of intracranial pressure in cases of acute craniocerebral trauma by means of subtemporal decompression operations, by means of intravenous injections of hypertonic glucose solutions and by means of lumbar drainage earlier than six or seven days after the injury, is unsound, unwise, and their use should be abandoned.

(6) "Delayed intravenous injections of hypertonic solutions of glucose

with insulin," and "delayed lumbar drainage" may benefit an occasional case exhibiting a high intracranial pressure after one is sure that all active bleeding has stopped and is not likely to recur as a result of the reduction of intracranial pressure.

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THE IMPORTANCE OF ADEQUATE MASKING DURING OPERATION

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Some of us remember the time when caps with white short-sleeved suits were used by the operating team and were considered the *last word*, with rubber gloves only for the instrument passer to protect his hands from the carbolic solution in which the instruments were kept. Then a sterile towel was pinned on the white suit; then sterile sleeves and gloves for the operator; then sterile gowns and rubber gloves for the whole team; then gauze over the mouth; then masks of various types. The results in those early days as far as infection was concerned were astonishingly good, and it makes one wonder whether all the elaborate preparations used in the modern operating room are really essential. Nevertheless, with the present knowledge of infections and their dangers, a surgeon is not justified in leaving out a single precaution when taking the responsibility which he assumes each time he operates.

This is not a new topic and other articles have been written on the subject, but the matter seems to be of sufficient moment to again emphasize the importance of adequate masking in the operating room. The purpose of this communication, therefore, is to call attention to this link in the complicated chain of operating-room technic which is so often found to be weak or defective.

Adequate masking means the protection of the patient by suitable masks from organisms which may come from either the mouth or nose of the operator or any member of the operating team. Adequate masking may also protect the operator from virulent organisms expelled from the respiratory passages of the patient, especially during operations on the nose, lips, mouth and throat.

A number of investigations have been carried out to determine the distance that infected droplets from the mouth may be projected during the act of talking or coughing. Doust and Lyon,[1] during the World War, found that in ordinary, or in loud speech, infected material from the mouth is seldom projected to a distance of four feet, while during coughing infected material from the mouth may be projected at least ten feet. Neumann,[2] in a study of the bacteria of the nasal mucosa, examined over 200 individuals of whom 111 were regarded as normal. He found that diphtheroids were present in 98 to 100 per cent.; *Staphylococcus albus* in 98 per cent.; *Staphylococcus aureus* in 30 per cent.; *Staphylococcus citreus* in 12 per cent.; sarcinæ in 8 per cent.; pigmented micrococci in 8 per cent.; *Micrococcus roseus* in 4 per cent.; pneumococci in 4 per cent.; Friedländer's bacilli in 6 per cent.;

Lactis aërogenes in 4 per cent.; *Ozena bacillus* in 3 per cent.; *Bacillus coli* in 12 per cent.; molds in 2 per cent.; yeasts in 2 per cent.; *Bacillus mesentericus* in 3 per cent. In infections of the anterior nares various pathological organisms are found. The most important of such pathogenes are streptococci, staphylococci, pneumococci, influenza bacilli, and Friedländer's bacilli.[3] Thus it can be seen that bacteria of many varieties and of varying virulence are found in the anterior nares and without doubt during the process of ordinary breathing organisms may be dislodged with mucous particles and be expelled from the nose.

There is much difference of opinion among physicians as to whether compulsory masking during respiratory disease epidemics would be of value in checking the general spread of infection, and Kellogg and McMillen[4] came to the conclusion that in influenza epidemics, masking was able to reduce the dosage of infection not more than 50 per cent. It seems logical to believe, however, that if universal masking could be maintained with well-fitting, properly adjusted masks made of an impervious material which would block out the mouth and nose, both from spreading infection and from receiving infection, that the method might be well worthwhile. There is no doubt, however, that the percentage of streptococcus carriers in the operating personnel is greater during respiratory disease epidemics and in consequence post-operative wound infections occur more frequently during such epidemics in operating rooms where the personnel is inadequately masked.

In a most interesting and thorough bacteriological investigation of post-operative wound infections at the Presbyterian Hospital in New York by Meleney and Stevens,[5] in 1926, a number of important points were brought out, but unfortunately this report did not receive the attention it deserved. Their summary was that in April and May of 1925, an unusual number of serious post-operative wound infections occurred in clean cases, from which the hemolytic streptococcus was recovered. There was a high incidence of general streptococcus infections of all kinds on the wards. An examination of the operating staff revealed the fact that 33 per cent. of these individuals harbored hemolytic streptococci in their throats and one of the instrument nurses carried it in her nose as well. Most of the operators and nurses were not, at that time, masking the nose during operations.

Directly after the examination had been made, a virulent infection with the hemolytic streptococcus occurred following a hernia operation. Three members of the operating team for this case were among those harboring the hemolytic streptococcus, and one of these was the instrument nurse with the concurrent nose infection. The infected patient also carried hemolytic streptococci in his nose and throat. The serum of a rabbit immunized to the organism cultured from the infected wound strongly agglutinated the strains cultured from the nurse's nose and throat, but did not agglutinate the strains obtained from the patient's nasopharynx nor any of the other strains cultured from the operating personnel except for one strain which reacted weakly.

The serum of a rabbit immunized to the organism recovered from the nose of the nurse agglutinated in its turn the strain from the infected wound, and each strain completely absorbed from the serum produced by the other strain the agglutinin both for itself and for the homologous strain.

Culturally, the strains were in every way similar and belonged to a rare group according to their sugar fermentation reactions.

Organisms are discharged from the unmasked nose and mouth of individuals during speaking and from the nose during expiration.

The evidence is very strong that one of our cases of post-operative hemolytic streptococcus wound infection was caused by the transfer of the organism from the nose of the instrument nurse to the wound at the time of operation.

In another paper on the same subject in 1927, Meleney[6] said in part that when adequate masking was practiced by every person entering the operating room infections with the hemolytic streptococcus were reduced to a minimum even though positive cultures were found in the noses and throats of the operating personnel. He goes on to say that while infection from the noses and throats of the operating team was not considered by any means the only source of wound contamination, nevertheless, they are dangerous sources which are frequently overlooked.

When infections occur in clean cases where the operating team, or some member of it, have not had both the mouth and the nostrils covered, it is seldom that the opportunity presents itself to have the matter traced to its ultimate source as was done by Doctor Meleney, who was able to definitely identify infections from specific hemolytic streptococcus carriers. It should be borne in mind, however, that the nose and throat also harbor many organisms besides hemolytic streptococci, and I have little doubt that if a similar investigation could be made on post-operative wound infections in clean cases, other than those caused by the hemolytic streptococcus, that the source of the infection would be found in the nose in many instances. It has been demonstrated by Doust and Lyon[1] that masks made of from two to ten layers of coarse or medium meshed gauze do not prevent the projection of infected material during coughing.

There are many models of operating masks which are made of different kinds of materials, and new types are frequently being described. Whatever pattern is used, I am convinced that the material should correspond in impermeability to at least three thicknesses of a very closely woven muslin, having from sixty to sixty-five strands to the square inch, and that gauze alone, unless of fine mesh and many layers, should not be used for this purpose. Certain masks are fashioned so that a sheet of thin, flexible, impervious material such as rubber or cellophane, can be inserted between the layers and this of course, makes the mask impenetrable to infected material, either from the operator or from the patient.

A hood, which covers the hair, ears, nose, mouth and chin, if the mask portion is made of sufficiently impermeable material, is of course, the most effective protection for the patient. However, if the mask portion of this hood is made of thin material, as it so frequently is, which becomes wet through from the breath and thus becomes more permeable,[7] or when it is worn so that the nostrils are exposed, it is ineffective as a protection for the patient. A cap which covers the hair, with the addition of a separate mask of sufficient impermeability to absolutely prevent the projection of organisms through it when talking and breathing, and which is large enough to com-

pletely block out the mouth, chin and nostrils, is usually sufficient to adequately protect the patient. Well-fitting masks are quite comfortable and most of the difficulties complained of seem to be caused by masks which are too small.

Fogging of glasses may be controlled by masks fitting close over the bridge of the nose, and if that does not completely prevent the fogging in any particular case, then the use of one of the anti-fog preparations, in addition, will keep the glasses clear.

As one goes from clinic to clinic, the almost universal use of the operating mask can be noted, but the method of its use and its type varies greatly. Even in the operating rooms of the same hospital, going from room to room, one is struck by the lack of uniformity in the use of operating masks, there being no attempt to cover the nostrils by the operators in some rooms, while in others this precaution is insisted upon.

Every surgeon is vitally concerned with the absolute surgical cleanliness of each object which comes in contact with a wound in his operating room, but there are a considerable number who have apparently not realized the danger of transmitting infection to a wound because of inadequate masking. In this group are some well-known surgeons, who still wear their operating masks below their nostrils. The idea seems quite firmly fixed in the minds of these surgeons and also in many medical observers of surgical operations, that organisms from the nose, or from their own noses at least, are innocuous. This may actually be true at times, but when these times are no one can accurately prognosticate.

It does not seem quite consistent for an operator who is careful enough to change scalpels, after cutting through the skin in order to avoid carrying infection from the skin into the deeper tissues, or who uses "no touch" technic in securing a bone graft, *etc.*, to breathe into the wound during the entire operation with his nostrils unmasked.

It is seldom that every member of an operating team is free from nose or throat infection, especially in the fall and winter, and if the patient is not protected from organisms expelled by the infected individual, wound infection may follow. These infections may be unimportant and easily handled, but sometimes, they become serious and are followed by septicæmia and even death.

The body maintains a natural defense or resistance against infection which is effective in many instances, if ordinary aseptic measures are taken, but now and then where the patient is depleted by illness, or is let down by a long-drawn-out operation, or where tissues have been handled roughly, these defenses are weakened, and the organisms breathed or dropped into the wound from uncovered nostrils or other sources may gain a footing and serious infection may result. These infections may occur at any time, and the only reason they do not occur more frequently where proper masking is not carried out is because there are at the moment no particularly virulent infec-

tious organisms in the respiratory tract of members of the operating team, and because the patient's resistance is high.

We all know that occasionally infections occur in clean cases, where the patient is in good condition, and where as far as can be discovered there has been no break in technic either in the sterilization of supplies or in the operating room routine. In order to find the cause of these infections, it has been my experience that everything is investigated, catgut, and all other possible sources of contamination except a consideration of the failure of the operator and his team to be effectively masked, in those instances where this was not done.

In order to determine whether, under normal operating conditions, more organisms were dropped into a wound when the nose was unmasked than when both nose and mouth were covered, the following experiments were done under the supervision of Dr. W. C. Merkel, the Director of the Laboratory at the Union Memorial Hospital of Baltimore. The same operating room and the same operating team consisting of the operator, a first and a second assistant and the instrument nurse were used throughout the tests. As far as could be determined, all of these individuals were in good health and had no acute respiratory troubles. The time of the year was April and May, and the weather was clear. One clean operation was done, and then the tests were made with all conditions exactly the same.

A Petri dish containing heart muscle blood agar was placed on the operating table in front of each member of the team. The team assumed positions over the plates, not closer than twelve inches and not more than eighteen inches away. The usual amount of talking was done and the individuals moved as in an operation, turning heads and changing positions. Normal breathing was attempted and no effort was made to force air through the nostrils or mouth. The ordinary activities of the operating room were carried out, there being about the same movement of attendants that would ordinarily be found during a routine operation. On another table in the room was placed a control plate of the same media to test the air. All of these plates were uncovered for fifteen minutes under the conditions named above and were then closed and marked with the name, date and time of exposure.

The same procedure as outlined above was then repeated, with the nostrils uncovered but with the mouth carefully masked. Several of these group tests were made. The plates were incubated for forty-eight hours at 100° F. and the colonies counted. The organisms were cultured and identified. No attempt was made to work out the bacterial flora of the nose and mouth of the individuals in the experiment.

It may be interesting to cite the results in one of the group tests carried out as described above. For the operator, the number of colonies with the nose and mouth masked were twenty-nine; with mouth alone masked, thirty-four; or a difference of five colonies. With nose and mouth masked, three of the colonies were streptococcus; one pneumococcus; seven *Staphylococcus aureus*; six *Staphylococcus albus*; four diphtheroids; four subtilis; two sarcinæ; one mold; one miscellaneous. With the mouth only masked, seven of the colonies were streptococcus; three pneumococcus; four *Staphylococcus aureus*; four *Staphylococcus albus*; three diphtheroids; nine subtilis; one sarcinæ; one mold; two miscellaneous.

For the first assistant, the number of colonies with the nose and mouth masked were twenty-four and with the mouth alone masked, thirty-five, or a difference of eleven colonies. With the nose and mouth masked, seven of the colonies were streptococcus; one pneumococcus; six *Staphylococcus aureus*; five *Staphylococcus albus*; three diph-

theroids; one subtilis; one mold. With the mouth only masked, one of the colonies was streptococcus; one pneumococcus; ten *Staphylococcus aureus*; seven *Staphylococcus albus*; five diphtheroids; four subtilis; four sarcinæ; one mold; two miscellaneous.

For the second assistant, the number of colonies with the nose and mouth masked were twenty-one, and with the mouth alone masked, forty-four, or a difference of twenty-three colonies. With the nose and mouth masked, six of the colonies were streptococcus; two pneumococcus; six *Staphylococcus aureus*; two *Staphylococcus albus*; one diphtheroids; three subtilis; one mold. With the mouth only masked, eight of the colonies were streptococcus; twelve *Staphylococcus aureus*; nine *Staphylococcus albus*; five diphtheroids; four subtilis; two sarcinæ; one mold; three miscellaneous.

For the instrument nurse, the number of colonies with the nose and mouth masked were thirty-one, and with the mouth alone masked, thirty-eight, or a difference of seven colonies. With the nose and mouth masked, six of the colonies were streptococcus; two pneumococcus; ten *Staphylococcus aureus*; six *Staphylococcus albus*; two diphtheroids; four subtilis; one mold. With the mouth only masked, four of the colonies were streptococcus; fifteen *Staphylococcus aureus*; ten *Staphylococcus albus*; three diphtheroids; five subtilis; one mold.

In the room controls during these fifteen-minute periods, the number of colonies when the team was completely masked was twenty-nine; when the team had the mouth only masked, thirty, or a difference of one colony. With the team completely masked, one of the room colonies on the control plate was streptococcus; two pneumococcus; eight *Staphylococcus aureus;* eight *Staphylococcus albus*; four diphtheroids; five subtilis; one mold. With the team masking only the mouth, one of the colonies on the room control plate was streptococcus; eight *Staphylococcus aureus*; seven *Staphylococcus albus*; five diphtheroids; six subtilis; two sarcinæ; one mold.

A plate exposed in the operating field during a two-hour operation, every one being completely masked, showed seventy-one colonies. This large number of colonies grew even though the team was completely masked and it is reasonable to suppose that many more colonies would have grown had the mouth alone been masked.

The organisms identified in this plate of seventy-one colonies were twenty *Staphylococcus aureus*; twenty-six *Staphylococcus albus*; four streptococcus; three diphtheroids; nine subtilis; four sarcinæ; two molds; three miscellaneous. During the same two-hour operation the room control plates on the sterile tables showed sixty-eight, seventy-four, seventy-seven and ninety-three colonies, respectively. In this group the identified organisms varied, *Staphylococcus aureus,* thirteen to twenty-four; *Staphylococcus albus,* fifteen to thirty-eight; streptococcus, four to eleven; diphtheroids, six to sixteen; subtilis, two to eight; sarcinæ, four to eighteen; molds, one to two; miscellaneous, one to seven.

The plate on the suture nurses' table showed during this same operation eighty-one colonies, which were identified as twenty-four *Staphylococcus aureus*; twenty-three *Staphylococcus albus*; eleven streptococcus; six diphtheroids; eight subtilis; six sarcinæ; three miscellaneous.

A significant fact is that there were from five to twenty-three less colonies on the plates when both nose and mouth were masked than when the mouth alone was masked during a fifteen-minute period. This in itself should prove the importance of masking the nose as well as the mouth, as every additional group of organisms must be an added strain to the defense mechanism of the tissues.

In another group experiment in which the nose was unmasked for fifteen minutes, the number of colonies on the plates exposed to the team was from six to ten greater than on the room control plates.

It was very evident that the longer the time of plate exposure, under any of the conditions tried in these tests, the greater were the number of colonies

grown. For instance, in a two-hour exposure of room control plates in two different operating rooms, one showed ninety-six colonies and the other ninety-three colonies. The presence of so many organisms in the air of the operating rooms of a modern hospital is important.

Another significant fact redemonstrated in these experiments and one which is often lost sight of is that streptococci, pneumococci, staphylococci, diphtheroids and other organisms are constantly in the air of the ordinary operating room in which there is no air filtration. This brings to mind the fact that cases operated on before a crowd of observers from different sections of the country, who are both on the floor and in the stands, frequently have a stormy convalescence as far as infection is concerned.

Where the operating team is adequately masked, these infections are probably due to the increase in the number of organisms in the air, which have been projected from the unmasked noses of the observers. There is also, under these conditions, much more movement in the room and consequently more disturbance of the air-borne organisms. With these findings before us, it seems extraordinary that any wound ever escapes infection and gives an idea of the effectiveness of the body resistance against infection.

The teaching of the younger men is a great responsibility for the older surgeon, and it seems to me that it is a serious mistake not to inform them of the danger to the patient which may follow improper masking, and at least to set them a good example.

Naturally, the operating team will follow the lead of the operator, and if he fails to cover his nostrils, they also feel that they are correct if they do as he does. In fact, I have occasionally heard it said when adequate masking was suggested to younger men, that Doctor So and So does not cover his nose and what is good enough for him is good enough for me. An operator would hardly feel justified in insisting on his team being properly masked if he did not cover his own nostrils, although even this would be better for the patient than having the entire personnel inadequately masked.

There are undoubtedly some men who will say: "I do not cover my nostrils and do not intend to, as a mask over my nose is uncomfortable, my glasses become fogged, and furthermore my infection rate is very low." Maybe they are justified in that attitude, but after being made aware of the facts, if they were not before, it hardly seems likely that they would be willing to take even a chance on infecting a wound, when this particular chance can be so easily eliminated by the use of proper masking. Perhaps some of these men are in the same group with a celebrated surgeon, who said be had had no infections in twenty years. He was justified in the statement, as his house officers took care not to show him those cases which had become infected, although, as a matter of fact, infection developed in his cases occasionally just as infections sometimes occur, in spite of every precaution being taken to prevent it, to anyone who is doing active surgical work.

The demonstration by Doctor Meleney of the identity of the organisms found in the nose of the instrument nurse, who was inadequately masked,

and in the wound of the patient was definite proof of how post-operative wound infections may occur. Our own experiments show that more colonies are found on Petri plates exposed to an operating team with the mouth only masked than when both nose and mouth are covered. Dr. I. J. Walker[8] also proved conclusively that with a germ-proof mask which covered only the mouth of a carrier, with streptococci in both nose and mouth, that the streptococci would be deposited upon a Petri dish during the ordinary act of respiration.

Many times during an operation, with the patient in the usual prone position on the table, the operator's face is directly over the wound. The actual distance from the wound is seldom more than twenty inches, and it is frequently as close as twelve inches. Consequently, it is very disturbing, with the facts mentioned above in mind, to see an operator and his first assistant, without the nostrils being covered, lean over an open abdomen or an exposed brain, or any other wound for say an hour or longer, when one realizes that organisms from the nose are constantly being sprayed or dropped into the wound by the force of ordinary breathing. Infection may be carried to the wound by an inadequately masked suture nurse, who bends over the table and breathes on the sutures and ligatures while preparing and passing them. Let us look forward to the time when such breaks in technic will never be seen. Personally, I would not feel justified in operating on a patient without being adequately masked, and I certainly would not want to have any surgeon operate on me unless he were properly masked.

There is no question but that covering the nose as well as the mouth with a well-fitting mask made of germ-proof material should be a standardized procedure in every operating room for the entire operating personnel. I am optimistic enough to feel sure that, in spite of previous masking habits, every surgeon will cover his nose and mouth and will require similar masking for each member of the operating team, as well as attendants and on-lookers, when he apprehends clearly the added danger of infection to which he is exposing the patient unless adequate masking is used.

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TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

CLINICAL MEETING HELD MARCH 28, 1934, AT
MEMORIAL HOSPITAL, NEW YORK, N. Y.

CANCER OF THE STOMACH IN BROTHERS

DR. GEORGE T. PACK presented a man, fifty-two years of age, who was admitted to Memorial Hospital October 4, 1933, with the following history: Eight months before, he began to experience postprandial pain, which had persisted without relief. He had lost thirteen pounds in weight. He had never vomited. A bulky mobile tumor could readily be palpated in the epigastrium. There was no evidence of visceral or distant metastasis. Fluoroscopy and röntgenograms of the stomach showed a tapering annular filling defect of the prepyloric region of the stomach. Peristalsis was normal above the region. There was moderate dilatation of the stomach and a very slight residue at six hours. Hæmoglobin was 65 per cent. and the erythrocytes three and one-half million per cubic millimetre of blood. Gastric analysis, using the ergamine acid phosphate test, revealed a complete absence of free hydrochloric acid in the gastric contents and no occult blood.

October 9, the patient was given a blood transfusion of 600 cubic centimetres of unmodified blood, immediately prior to laparotomy. The tumor was found to occupy the pylorus, antrum and part of the pars media. It was resected without difficulty after which a posterior Polya-anastomosis was done in an isoperistaltic direction. Convalescence was quick and uneventful. The excised tumor measured thirteen by nine centimetres. It proved to be an adeno-carcinoma of tubulo-alveolar structure with a histological grading of three. The border of the excision was free of cancer, although the gastric glands showed hyperchromatic changes suggestive of a further tendency to the development of a similar process.

While this patient was in Memorial Hospital, his older brother, aged fifty-four years, stated that he had lost ten pounds in weight during the past month for which he could not account, except perhaps due to worry about his brother. This older brother, who was now presented by Doctor Pack, was in excellent health and had a good appetite and digestion. He never experienced nausea, vomiting, abdominal pain or discomfort. Because of his apprehension, a gastro-intestinal X-ray study was made, which revealed a carcinoma in the prepyloric segment. This tumor could not be palpated through the abdominal wall. Gastric analysis, using the ergamine acid phosphate test, revealed a complete absence of free hydrochloric acid in the gastric contents and occult blood in each specimen.

The first patient was discharged October 27, on which date his elder brother was admitted to the ward to occupy the same bed. October 30, a laparotomy was done; the carcinoma was situated mostly on the lesser curvature of the stomach where it extended to a point about six centimetres from the cardia. The tumor fungated through the serosal layer of the stomach and infiltrated the gastrohepatic omentum. The resection was greatly facilitated by the use of the von Petz sewing clamp; a Billroth II resection and anastomosis was done.

The patient had a stormy convalescence, recovering from bronchopneumonia, pyelitis and duodenal fistula. Two blood transfusions each of 600 cubic centimetres of unmodified blood were given post-operatively. At the present time, seven months later, both brothers are in good health and each has gained twenty-four pounds in weight. Subsequent X-ray studies have showed no evidence of recurrence.

The surgical specimen consisted of a portion of the stomach fifteen centimetres in length. Along the lesser curvature and extending into the gastrohepatic omentum was seen a granular subserous carcinomatous process measuring seven centimetres in length. On the mucosal aspect of the tumor was a crater 3.5 centimetres in diameter. Microscopical examination revealed an alveolar and diffuse adeno-carcinoma, grade III, with areas of typical malignant colloid adenoma.

It is not remarkable for cancer to occur in two brothers, but the common location in the stomach is rather unusual. If this occurrence were coincidental, there were some striking similarities in these two cases, *viz*: Both cancers were situated in the pylorus and were in an operable stage. They were classified histologically as adeno-carcinomas, grade III, in both instances. The brothers were in the same five-year age period, which is of great importance either from the viewpoint of heredity or from the conception of prolonged chronic irritation as the causative factor. The signs and symptoms of the cancer in the second brother were so insignificant as to have escaped detection, were it not for the first brother's immediately recent experience. The fact that the diagnoses were made within two weeks is solely coincidental and no significance can be attached to it.

Careful investigation into the family history over four generations revealed no other case of cancer. Four sisters and a younger brother were in good health. The two patients were of close physical resemblance. They had the same habits of eating, none of which could be interpreted as particular cancer hazards.

The case histories were presented to Dr. Madge Thurlow Macklin with an enquiry concerning the expected frequency of such an occurrence as the same type of tumor in brothers. Doctor Macklin's data may be summarized as follows: There are in Canada 232,500 men between fifty and fifty-four years of age. Of these, 177 died of carcinoma of the stomach or duodenum, or one in every 1,313 men at that age will have this particular localization of the cancer. The occurrence of carcinoma of the stomach in two brothers between the ages of fifty-two and fifty-four would occur only once in 1,723,969 persons. If the age were mere coincidence, with which Doctor Macklin did not agree, then the chances grew even less. Thus 1,569 males in Canada died of cancer of the stomach out of 5,300,000 males in 1932; or one in every 3,384. On the basis of this reasoning, to find two males in the same family with such cancers would conceivably occur only once in 11,451,456 times.

The brother, sisters and cousins of these patients are to be observed at intervals in the gastric clinic where occasional gastric analyses and röntgeno-

grams of the stomach should detect any early evidence of cancer, if there is any familial tendency here.

METASTATIC NECK NODES

Dr. William Watson presented R. T., aged forty-five, admitted to the head and neck service of Memorial Hospital, December 21, 1933, with a two months' history of swelling in both sides of the neck and dyspnœa, orthopnœa, and dysphagia. A tonsillectomy two weeks prior to admission had not improved matters. Local examination showed a rather bulky, pinkish-red, ulcerated and granular lesion at least four centimetres in its greatest diameter, arising in the left tonsillar fossa. There were huge bilateral neck metastases which were responsible for the respiratory difficulties.

Röntgenogram of the chest showed the lung fields clear. Biopsy of the tonsillar lesion and aspiration biopsies of both cervical nodes were reported by Doctor Stewart as lympho-epithelioma, grade IV, radio-sensitive, metastatic to nodes.

Treatment was carried out on the radium element pack and he was given 100,000 milligram hours at ten centimetres with a six-centimetre cone. A tracheotomy was done at the start of his treatment. There was complete regression of both primary and metastatic disease. The patient developed erysipelas and had to be sent home. He then returned, five weeks later, with a node four centimetres in diameter in the left lower neck. This was treated by surgical exposure and insertion of gold-filtered radon seeds.

CARCINOMA OF CORPUS UTERI

Dr. William P. Healy operated upon F. S., a female, aged sixty-eight, married, para eight. No miscarriages; was admitted to clinic March 5, 1934. She stated that she had always enjoyed good health and gave a history of normal menstruation followed by menopause eighteen years ago. The initial symptoms of her present illness occurred three years ago, when she noticed a scant, brownish, watery vaginal discharge that lasted three or four days and appeared at infrequent intervals. Gradually the intervals became shorter, the duration longer and small amounts of blood were noted. She consulted her physician but was told not to worry. The discharge persisted and for the past four months has been constant, foul, and tinged with blood. Occasionally small clots were noted. Upon the third visit to her physician several days ago, she was referred here for treatment. The discharge has been painless and not associated with any systemic disturbances or loss of weight.

General physical examination negative, except for a moderate cardiac enlargement. Blood-pressure, 222/98. Pelvic examination: Vulva and vaginal canal negative. Cervix small, senile. Corpus cannot be mapped out, but does not give the impression of being enlarged, especially the adnexa. Tentative Diagnosis: (1) Atrophic endometritis with polyp and pyometra. (2) Carcinoma of corpus. Operation: (1) D. and C. diagnostic and therapeutic. (2) Corpus tandem, dose to depend upon pathological findings.

BONE CYST

Dr. Bradley L. Coley operated upon B. M., a nine-year-old girl of Italian parentage who was of normal health and development until present illness. About eight months ago patient fell, bruising right hip. The ecchymosis and tenderness disappeared within a few days. About four months ago parents noticed that child limped slightly and complained she had pain

in region of right hip, radiating down anterior and inner surface of thigh. The symptoms slowly became more marked in spite of local applications. She was admitted to another hospital, where the diagnosis was made, and referred here for operation.

Physical Examination.—A somewhat undernourished child of nine years with poor muscle tone and moderate lordosis. She has a slight limp on right side. General examination is essentially negative. The right leg is three centimetres longer than left, the right iliac crest being noticeably higher; this overgrowth is confined to the thigh. There is no tenderness, spasm, muscle atrophy nor limitation of motion at right hip joint, but flexors of right thigh are weaker than those of the left. Blood: red blood-cells, 4.3 million; hæmoglobin, 85 per cent. X-ray shows a bone cyst of right femur.

Operation.—Curettage and cauterization of cyst. Application of spica.

CARCINOMA OF RECTUM

Dr. George E. Binkley operated upon C. M., male, forty-seven years old, whose general health was always good until present illness. Previously his bowels moved twice daily without laxatives. About one year ago he first noticed increased frequency of defecation and a tendency to diarrhœa. About eight months ago he noticed pain on defecation, and a small nodule protruding from anus on straining. Six months ago the nodule became permanently prolapsed. He thought he had hæmorrhoids, consulted a doctor, who did an operation (apparently the removal of some tissue). He was advised to go to Newark for X-ray treatments, but failed to do so. Following the operation he has had occasional episodes of rectal bleeding. He has lost strength and weight (thirty pounds) and has had constant rectal pain for a month, as well as watery diarrhœa. Two weeks ago he consulted another doctor for the first time since his previous treatment, and was referred to this hospital.

Physical Examination.—An undernourished, pale, sick-looking man. General examination negative. Liver not palpable, no distention or ascites. Inguinal glands palpable but not enlarged.

Rectal Examination.—There is a large, purplish, fungating, hard, nodular tumor protruding from anal canal and extending upward into the rectum which bleeds easily on examination. It is not definitely fixed to the pelvic walls, but because of extreme tenderness complete examination is difficult. The anal cavity is greatly narrowed, but a small proctoscope may be passed above the growth. Biopsy shows adeno-carcinoma, grade II-plus.

Two X-ray treatments of 500 R each were given to perineum before admission, which relieved pain considerably. He will now have colostomy made.

CARCINOMA OF BREAST

Dr. Frank E. Adair performed a radical amputation of the breast on T. D., a fifty-nine-year-old female who was first seen in the breast clinic on January 30, 1934, and at that time complained of a lump in the upper outer quadrant of the right breast, of three years' duration. Since first noticed this mass has increased but little in size. About one year ago she noticed a smaller mass mesial to the original one, and it has behaved in like manner. They have caused her no discomfort, and there has been no discharge from the nipple at any time.

Physical Examination.—Negative except for the following: Blood-pressure, 160/70. Rhythm regular, except for occasional extrasystole.

Sounds of good quality. Soft systolic murmurs over mitral and aortic areas. Breasts: At that time there was a hard, immovable, non-tender tumor infiltrating the skin in the upper outer quadrant of the right breast. It was four centimetres in diameter. The skin overlying the mass was pink in color. About four centimetres medial to the above tumor was a similar one about 1½ in diameter. The breast was freely movable and the nipple normal in character. In the axilla there were several small, freely movable nodes. None were palpable either in the infraclavicular or supraclavicular spaces. The left breast was essentially negative. Aspiration biopsy on that day confirmed the clinical diagnosis of carcinoma. X-ray of chest revealed no metastases.

Pre-operatively she received four cycles of 300 R. each through six ports, beginning January 31, 1934, and completing it February 12, 1934. This produced moderate skin reaction and rather marked regression in the primary tumors and axillary metastases. On admission to the hospital the larger mass was about two centimetres in diameter and the smaller about one centimetre, and only one node could be palpated in the axilla. The skin was pigmented, but in good condition.

CARCINOMA OF BLADDER

Dr. Benjamin S. Barringer performed a suprapubic cystotomy and inserted gold radon seeds in a fifty-two-year-old woman with a history of two years of dull pain in the left lower abdomen, radiating to left costovertebral angle, and constipation. An appendicectomy was done elsewhere in January, 1934, which relieved pain and constipation; but following which nocturia, urgency, frequency and dysuria appeared. She was told that her bladder was found to be diseased at operation. About two weeks ago hæmaturia first appeared. One week ago she was cystoscoped and referred to this hospital.

Examination.—An obese woman of fifty-two years in fair general condition. Abdomen negative to palpation. Vaginal touch reveals dense induration of right side of bladder base extending to mid-line. Cystoscopical examination reveals a slough-covered ulcer of right side of bladder base, posterior to right ureteral orifice. Biopsy from bladder reported epidermoid carcinoma, grade II-plus.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD APRIL 11, 1934

The PRESIDENT, DR. ALLEN O. WHIPPLE, in the Chair

ACUTE SPINAL EPIDURAL ABSCESS

DR. IRA COHEN presented a child, six months old, admitted to the pediatric service of Mount Sinai Hospital. Six days before coming to the hospital he became restless, refused his feeding, seemed prostrated, and was found to have a temperature of 103°. The fever continued, fluctuating between 99° and 103°. On the day of admission, rigidity of the neck appeared. There was no history of an acute respiratory infection, nor of convulsions or vomiting. Aside from a rigid neck, slight Babinski reflex, infection of the pharynx and fever, examination disclosed nothing abnormal, though at times he seemed to have twitching of his left arm. On the negative side were a flat fontanelle, free motion of all extremities, normal and equal deep reflexes, and absent spine tenderness. A lumbar tap yielded xanthochromic fluid containing 150 cells of which 70 per cent. were polynuclear leucocytes. The blood showed a moderate secondary anæmia and a slight leucocytosis. When a second lumbar puncture was done three days later only a few drops of xanthochromic fluid could be obtained. No manometric tests were done. A diagnosis of a pachymeningitis hæmorrhagica was entertained.

There were no additional facts noted for nine days during which time the temperature ranged about 100°, with an occasional rise to 102° or 103°. On the ninth day a paralysis of both arms was noted. This was not complete as some motion of the shoulder and fingers remained. Except for an active triceps and radial reflex on the right, and triceps on the left, the reflexes were lost. Sensation seemed normal. At this time an X-ray examination of the spine disclosed no abnormality. The following day the legs became spastic with clonic knee-jerks but normal ankle-jerks. The next day motion was impaired in the legs and sensation in the arms was lost, and a small swelling in the paravertebral lumbar region was noted. The following day Doctor Cohen saw the child. First, the subarachnoid space was aspirated through the fontanelle from which clear fluid was obtained. When a lumbar puncture needle was introduced in the lumbar region, pus escaped from it before it penetrated the dura, and pressure on the lumbar swelling increased the flow of pus. A diagnosis was made of an epidural spinal abscess arising in the cervical region and perforating in the lumbar, due either to an osteomyelitis of a cervical vertebra or metastatic from the nasopharynx.

Operation.—A curved incision about four inches in length was extended from the lumbar swelling over the spinous processes from lumbar one to four. In the musculature thick pus was encountered which could be seen coming from the spinal canal where an erosion of the second lumbar arch was noted. A small laminectomy of the second and third lumbar vertebræ was done and thick pus poured down in the epidural space. A small soft rubber tube seven inches long was passed up the canal and the wound packed open. A culture of the pus showed an hæmolytic streptococcus.

In six hours, improvement in the power of the arms was noted. This continued so that in two weeks no residue could be demonstrated. On the fifth post-operative day X-ray examination of the cervical spine was still negative. The following day the tube was replaced by a small catheter and the next day iodized oil was introduced; this ascended to the seventh cervical vertebra. The wound was practically healed three weeks after operation. A respiratory infection held the child in the hospital another three weeks. Today he seems normal in every way.

This case is of interest first because of the extreme youth of the patient. Of some fifty-five cases of epidural spinal abscess, either due to extension from the vertebra or metastatic, recorded in the literature, no patient under eleven years is reported. A second point is the prompt and complete recovery. Of these fifty-five cases, thirty-eight died. The third interesting feature is the surgical treatment employed. Although there is every reason to believe that the infection started in the cervical region, the drainage by lumbar laminectomy proved adequate.

Doctor Cohen remarked further that in this case there was a very definite abscess in the lumbar region and no very definite localization in the cervical region where the abscess had arisen. He felt that a search for the lesion in the cervical region might well have been troublesome and recalled another instance in a patient with an osteomyelitis of an upper thoracic vertebra in which the spinous process was exposed lying in a pool of pus and where drainage at the site of the primary focus had failed to effect a cure, and lumbar laminectomy to drain the epidural space had to be done. In the case of this child, Doctor Cohen had believed that he could succeed with a simple procedure which fortunately proved to be correct.

CHRONIC SUBDURAL HÆMATOMA

Dr. Ira Cohen presented a woman twenty-seven years of age, who on August 31, 1933, came under observation because of intense headache of a month's duration. At the onset the headaches were right frontal and infrequent. They then were noted daily, finally becoming constant and general. Shortly after the onset she began to vomit and this occurred daily, sometimes several times a day. There was a very indefinite history of buzzing in the ears, flashes of light and vertigo. All symptoms had increased following a lumbar tap done several days previously. An additional, but a most important, fact was the history of two falls, one eight months prior to admission, just a month before the birth of her second child; the second, two months before the onset of the headaches, when she tripped while walking on the street and sustained a laceration over the left eyebrow, and was momentarily stunned. She had been bedridden since the lumbar puncture.

She looked very ill, pulse 44. She was unable to sit. Her neck was rigid but there was no Kernig. There was early papillœdema, very slight flattening of the right face, and paresis of the right external rectus. The deep reflexes were bilaterally exaggerated, a shade more so on the right, and a bilateral Babinski response was obtained. It was felt that air studies would be needed for localization, but because of the few signs pointing to the left hemisphere and the history of trauma, it was decided to place the first trephine opening on the left. This was done the day after admission to the hospital. Through the opening thus made over the occipital lobe, a typical appearing hæmatoma was encountered. About 20 cubic centimetres of old blood was

allowed to escape and the wound was sutured as preparations had not been made for a more extensive operation at that time. The following day an osteoplastic flap was turned down on the left side. After opening the dura the hæmatoma was seen covering the entire hemisphere except part of the temporal lobe. It was in part fleshy, but was readily removed. The brain did not expand promptly. A decompression was left. After the flap had been sutured, a button of bone was removed from the right frontal region to exclude a bilateral lesion. Nothing pathological was noted.

In her immediate post-operative course she still showed a relative bradycardia with unexplainable jumps to 140. She was drowsy at times and vomited. Had it not been for the negative right-sided exploration we would have worried about the possibility of a hæmatoma on that side. The vomiting and headache persisted over a week after operation and diplopia appeared. A lumbar puncture yielded light xanthochromic fluid. It was noted that a third nerve paresis on the right was present. Twelve days after operation 15 cubic centimetres of old blood was aspirated from beneath the flap, and while one could not be sure, it was felt that this blood lay between the dura and the bone. The following day a similar amount was withdrawn. From that time on improvement set in, the paresis of the third nerve improved, but even up to the time she left the hospital, on the twenty-first post-operative day, it was present, as was the papilloedema. Shortly after her discharge all signs cleared up.

This patient is one of ten such cases which have come under my care in the past few years. It is not always easy to obtain the history of trauma. In some instances a less extensive procedure such as emptying the fluid content through a trephine opening may suffice. But where, as in this case, a fleshy organized mass is found, removal through an osteoplastic bone flap has seemed to me the wiser course. Most frequently hæmatomas were apt to follow blows on the back or front of the head and not so likely on the side. For this reason he thought that probably the second fall with the laceration above the eyebrow had done the damage. He knew, as Doctor Stookey had pointed out, that there were hæmatomas in which the contents of the sac were fluid and which could be adequately cared for by trephine opening only, but in cases such as he had presented this evening where the hæmatoma was a thick and fleshy one, he thought it was best cared for by actual removal.

CHOLEDOCHOLITHOTOMY

STONE OCCLUDING COMMON DUCT AFTER CHOLECYSTECTOMY, WITH FISTULA BETWEEN STUMP OF CYSTIC DUCT AND DUODENUM

Dr. Condict W. Cutler presented a woman, sixty-two years of age, who was admitted to the Roosevelt Hospital on January 29, 1932. Her chief complaint was pain in the epigastrium, chills, fever and jaundice.

Present History.—The patient had a cholecystectomy performed for cholecystitis in 1920, at a New York hospital, twelve years before the present illness. She was well until five months before this admission. In August, 1932, she developed severe epigastric pain which persisted for three days. The pain radiated to both arms and shoulders and to the back. There was much belching of gas, but the patient did not vomit. She became deeply jaundiced. At this time she remained in the hospital for three weeks, with gradually diminishing pain and jaundice. Since that time, and until three weeks before this admission, the patient gradually regained weight and strength. There was occasional mild epigastric discomfort, but no nausea or vomiting. Three weeks before admission the patient suffered another severe

attack of epigastric pain. There was a chill and her temperature rose to 104°. She improved over a period of several days, but remained in bed. A week later, jaundice developed, with pruritus. On the day before admission severe epigastric pain developed, radiating as before to the back and followed by deepening jaundice. There was again chilliness and fever. For the past three weeks before admission there had been loss of appetite and marked loss of strength and weight.

Examination showed a patient markedly jaundiced and rather emaciated. Weight, 106. Slight epigastric tenderness. Hæmoglobin, 70 per cent.; red blood-cells, 3,500,000; white blood-cells, 9,000; polymorphonuclears, 60 per cent. Sedimentation rate, 44 millimetres per hour. Bleeding time, 1 minute; clotting time, 1 hour + icterus index, 75. Van den Bergh: positive, immediate, direct. Bile in urine. Also a little in stool. X-ray negative. Temperature normal four days. Fifth day chill with temperature 103.2° and increased pain and jaundice. Glucose infusions (5 per cent. in saline) 1000 cubic centimetres on eighth, ninth, tenth days.

Operation.—February 7, 1933, gas, oxygen, ether anæsthesia. The old cholecystectomy scar was excised. No muscle approximation was found. There were numerous dense adhesions binding omentum and intestines to parietal peritoneum and omentum, colon and duodenum to the edge and undersurface of the liver. These were divided and the common duct exposed. This was distended and thick-walled. No stone was felt. The head of the pancreas was hard. The duct could not be mobilized nor the finger introduced into the foramen of Winslow because of adhesions and the interference of a structure, cord-like in nature, which, departing at a sharp angle from the outer upper surface of the common duct, attached firmly to the duodenum an inch or more distal to the ampulla of Vater. This was freed and identified as the stump of the cystic duct. The end which was attached to the duodenum was severed close to the gut wall, whereupon bile escaped from the end of the duct and also from the duodenum in which was found a small opening. This opening in the duodenum was sutured.

It was now possible to expose the common duct throughout its length. A stone was felt impacted in it at the ampulla. The duct was opened and bile escaped. A quantity of white mortar-like substance and biliary "mud" was removed from the duct, where it lay impacted behind the stone. The stone was now grasped and removed with some difficulty. It was 1.5 centimetres in diameter. A probe was now passed freely into the duodenum and the tip of the little finger was used to explore the freed opening. The common duct and hepatic radicles were flushed with saline solution. A "T" tube was introduced into the common duct. The stump of the cystic duct, from which bile was escaping, was now ligated close to the common duct and amputated. It contained white, mortar-like material. The wound was closed about the "T" tube and a small Penrose drain, muscle layer approximation being secured. The tissue removed was described as cystic duct, showing chronic inflammation.

Post-operatively the temperature rose to 102.8°, subsiding to normal on the fifth day. Profuse drainage of bile from the "T" tube persisted to the eighteenth day, when the tube was removed. Bile drainage ceased on the twenty-third day. Jaundice had then cleared. There was bile in the stools and none in the urine. Icterus index was 19.5. Patient was discharged on the twenty-eighth day (March 7, 1933). One month after discharge there was still slight mucoid drainage from the sinus. Last seen November 16, 1933. No complaints. Has gained 26 pounds in weight and strength. Scar firm. Now weighs 132 pounds.

DR. FRANK MATHEWS said that one of the points of interest in Doctor Cutler's case was the long interval—over ten years—between the performance of the cholecystectomy and the symptoms of the common-duct stone. However, he recalled several cases of his own with a similarly long interval. Whether there was a definite pathology in the common duct all that time, it would be difficult to say. It would be interesting to speculate as to whether a small stone had been left in the cystic duct which ultimately ulcerated into the duodenum, finally causing the fistula. At any rate the fistulous tract through the cystic was not large enough to cause adequate bile drainage into the intestine. Doctor Mathews had once used the cystic duct to establish biliary drainage into the duodenum. A catheter was introduced into it and then passed into the duodenum through a small opening. In this case the drainage tract remained adequate, though it was known that in this patient no bile had drained through the common duct into the duodenum. In some common-duct cases he has found it very convenient to drain externally by means of a tube passed into the common duct through a dilated cystic duct.

SUBTOTAL THYROIDECTOMY FOR GRAVES' DISEASE

In a Girl Twelve Years Old

DR. RICHARD LEWISOHN presented a girl now thirteen years old who was admitted to Mount Sinai Hospital on September 14, 1932, complaining of marked restlessness and nervousness for the last eighteen months. She had lost 24 pounds in weight. Upon admission she showed all the signs of marked hyperthyroidism, flushed facies, rapid pulse, and marked tremor. There was a systolic murmur at the base with a marked presystolic gallop at the apex. Blood-pressure on admission, 132/84, basal metabolic rate, +52. There was a marked exophthalmos. After two weeks' rest in bed Lugolisation was started and the right and middle lobes were resected on October 13, 1932. After an uneventful post-operative course, the left lobe was resected on November 10, 1932. The patient left the hospital with a basal metabolic rate of +7.

Her condition has improved continuously since the operation. When seen recently in our follow-up clinic, the patient weighed 119 pounds; her pulse rate was 96. Her nervousness and tremor have disappeared entirely. Her heart action is perfectly regular. Her exophthalmos persists though the mother claims that the eyes have receded. Her basal metabolic rate is now −2.

This case is presented in order to show the good results which may be obtained by surgery in juvenile hyperthyroidism.

DR. EMIL GOETSCH said that Doctor Lewisohn had called attention to an interesting group of clinical cases, namely, those children suffering with Graves' disease and other types of hyperthyroidism. Exophthalmic goitre occurring in children is comparatively rare. In a survey of the literature of the twenty years prior to 1922, Buford found only eighteen cases of exophthalmic goitre in children under twelve years of age and, of these, eight were in children under five years. In 1901 Barret collected thirty-nine cases under fifteen years of age. Three of these patients were under five years of age. He esti-

mated that the ratio of children to adults was one to fifty. Cases of exophthalmic goitre occurring in children under four years of age have been reported.

In the statistics from the clinic of Doctor Goetsch, there is a rapid increase in the occurrence of exophthalmic goitre after twelve years of age. Exophthalmic goitre in children is treated in much the same way as in adults. It may be stated, however, that, inasmuch as in practically all the children the disease is very toxic, there is accordingly a greater need in some cases for stage operations. When thus safeguarded, thyroidectomy results in no greater mortality in children than in adults. When it is possible to take a metabolic rate, it is generally found to be high. Metabolism tables have not been worked out satisfactorily in children but it is possible to make fairly accurate estimates of the rates. Lugol's solution is used pre-operatively in the same manner as in the adults though in smaller doses. Since its introduction, stage operations are only occasionally necessary.

It has been taught by some that the resection should be less radical in a child because of the future growth period. Doctor Goetsch, however, felt that inasmuch as there was a marked tendency for growth and hyperplasia of the thyroid gland in children, resection should be equally radical with that in the adult. He thought it might be of interest to say a few words about the occurrence of exophthalmic goitre and hyperthyroidism in children at the Long Island College Hospital during the thirteen years from 1920 to 1933 inclusive. During this period there were 3,031 patients operated upon for various types of goitre. Fifteen of these 3,031 patients, namely, .49 per cent. or in the proportion of one in two hundred cases, were children of twelve years of age or under. Twelve of the fifteen children suffered with exophthalmic goitre and three adenomatous goitre. The cases group themselves according to age as follows:

Age 4 years—1 case —exophthalmic goitre
Age 5 years—1 case —exophthalmic goitre
Age 7 years—1 case —adenoma of the thyroid
Age 9 years—2 cases—exophthalmic goitre
Age 10 years—1 case —exophthalmic goitre
Age 11 years—2 cases—exophthalmic goitre
Age 12 years—7 cases—5 exophthalmic goitre
2 adenomatous goitre

Double lobectomy was done in one stage in nine of the twelve cases of exophthalmic goitre. In the remaining three, stage operations had to be done. In the first case operated upon before the pre-operative use of iodine, a three-stage operation was done, namely, double superior ligation followed by right and subsequently left lobectomy. In the second case a three-stage operation was also required, namely, single superior ligations followed by double resection and in the third case a double resection was done in two stages. The three cases of adenomatous goitre were all operated upon in one-stage operations. There were no fatalities in the twelve cases of exophthalmic goitre operated upon. There was one fatality following operation in the case of a

young girl, twelve years of age, who was a cretinoid individual and who required thyroid feeding together with periods of iodine treatment throughout her life from the time she was three months old. She had a very large adenomatous goitre involving the whole thyroid gland with extensive prolongation into the mediastinum and consequent serious tracheal obstruction. It was largely as an emergency measure to relieve the tracheal obstruction that the operation was done. The operation *per se* was well borne but during the night following operation, patient developed peculiar type of general convulsions, hyperpyrexia and died the following morning. The exact cause of death could not be determined.

DR. MORRIS K. SMITH recalled a patient of his upon whom he operated upon for exophthalmic goitre when she was twelve years old, the same age as Doctor Lewisohn's patient. The immediate result was good but before long there was well-marked hypertrophy of the gland remnants and evidence of mild recurring or continuing toxicity. At the present time she has no complaints and her basal metabolism is normal on iodine medication. The course of this patient has been of interest with regard to the question of conservatism in thyroidectomies on children as the resection in this instance had been less radical than that usually carried out in adults.

SECONDARY GASTRIC RESECTION FOR PERFORATED GASTROJEJUNAL ULCER WITH PERITONITIS

DR. RICHARD LEWISOHN presented a man, fifty-three years old, who was first admitted to the surgical service at Beth Israel Hospital on January 22, 1924, with the following history:—He had been suffering from stomach trouble for six years. His complaints consisted chiefly of occasional burning pain in the epigastrium, sour eructations and constipation. There was no vomiting. For the past two months his symptoms had become greatly exaggerated. He now had pain just above the umbilicus which was severe and radiated to the right and to the left. The pain most frequently came on at night. Recently the pain had increased in frequency and had no relation to his meals. Vomiting had been associated with the pain for the past two months and came on fifteen minutes after eating. Upon one occasion in the past week blood was noted in the vomitus.

His past history was essentially negative. Physical examination was negative except for some tenderness in the umbilical region with the point of maximum tenderness just below the umbilicus. There were no palpable masses. A test meal showed a free hydrochloric acid of 20 and a total acidity of 36. No blood was present in the fæces. X-ray examination of the gastro-intestinal tract showed the stomach to be normal in size, shape and tone. The duodenal cap was not filled. Six hours observation failed to show evidence of residue.

Operation.—February 13, 1924: the gall-bladder was normal. The transverse colon was pulled up by adhesions to the gall-bladder and the duodenum. A small hard mass was felt just beyond the pylorus. The pylorus was very narrow and contracted. A scar was seen in this region. Through a right rectus incision a gastric resection with gastrojejunostomy (Hofmeister technic) was performed under local anæsthesia. No ulcer was seen on the specimen. Possibly the line of dissection had been carried through the small

lesion. The wound healed by primary union and the patient was discharged well, fourteen days after operation.

He felt well for six months after this operation. After this free interval, pains recurred with free intervals lasting for six to eight weeks, and he was admitted to Mount Sinai Hospital for observation in November, 1926, on account of frequent vomiting and belching. He was unable to work. The X-ray examination of the stomach was essentially negative. The stoma was regular and not tender. Rehfuss test-meal showed free hydrochloric acid 35, total acidity 65. It was felt that he suffered from post-operative adhesions or a recurrent ulcer. In view of the negative X-ray findings, operation was not advised.

On March 3, 1927, this patient was readmitted to Beth Israel Hospital with a sudden attack of very severe epigastric abdominal pains for four hours. This pain had been present up to admission and was not accompanied by nausea or vomiting. Physical examination revealed a man apparently in great pain. The local physical examination revealed extreme rigidity of the entire abdomen especially of the upper half. There was tenderness in the epigastric region. There was no distention. The provisional diagnosis was perforated peptic ulcer, probably gastrojejunal. A flat plate of the abdomen showed a slight elevation of the diaphragm on the left side. There was no evidence of any free air in the peritoneal cavity. The blood count showed 12,400 leucocytes with 50 per cent. polynuclear lymphocites.

Operation under spinal anæsthesia, supplemented by nitrous oxide and oxygen with ether for the closure of the abdominal wall. Exploration through an upper mid-line incision showed some turbid fluid. A perforation was encountered in the jejunum near the gastroenterostomy stoma, about the size of a finger-nail. Its walls were markedly indurated and the induration extended into the mesentery of the jejunum. The gastroenterostomy stoma had become narrowed. A safe closure of the perforation appeared impossible on account of the extension of the inflammation to the mesentery of the jejunum. Accordingly the stomach was divided about three inches above the previous resection, after the individual vessels had been clamped. The distal part of the stomach with the stoma and the perforated ulcer were resected *en masse* (Fig. 1), after the mesentery of the affected part of the jejunum had been ligated and the distal and proximal end of the jejunum beyond the ulcer had been cut across. The end-to-end anastomosis between the cut ends of the jejunum had to be effected about one inch beyond the foramen of Treitz. A two-layer suture anastomosis was performed. The stomach was then anastomosed to the jejunum about two to three inches below the jejunal anastomosis, according to the Hofmeister technic (Fig. 2). One drainage tube was put into the abdomen, and the abdominal wall closed in two layers, chromic catgut being used for peritoneum, muscle and fascia and silk for the skin.

The specimen showed a portion of stomach and jejunum anastomosed by gastroenterostomy with a large punched-out perforated gastrojejunal ulcer, which admitted one finger. This ulcer was surrounded by an area of extensive induration. Section taken at the junction of the jejunum and the stomach showed the mucous membrane of the jejunum to be present, greatly infiltrated with mononuclear cells and an occasional polynuclear cell. The mucous membrane extended to a point where it was undermined. The rest of the section showed a complete absence of the mucous membrane. At a point where the mucous membrane was absent there was an acute inflammatory exudate resting on a fibrinous base. There was a great deal of chronic in-

flammatory infiltration. Beyond the fibrous base the muscle coat was still present. It showed a great deal of chronic inflammation. The entire section showed a marked degree of congestion.

The patient made an uneventful post-operative recovery. The abdominal wound healed by primary union. The patient was symptom-free on discharge, twenty-three days after the secondary operation. He has been in perfect health ever since his last operation, works continuously and does not keep any special diet. The Rehfuss test-meal, taken recently, shows: free hydrochloric acid 18, total acidity 34.

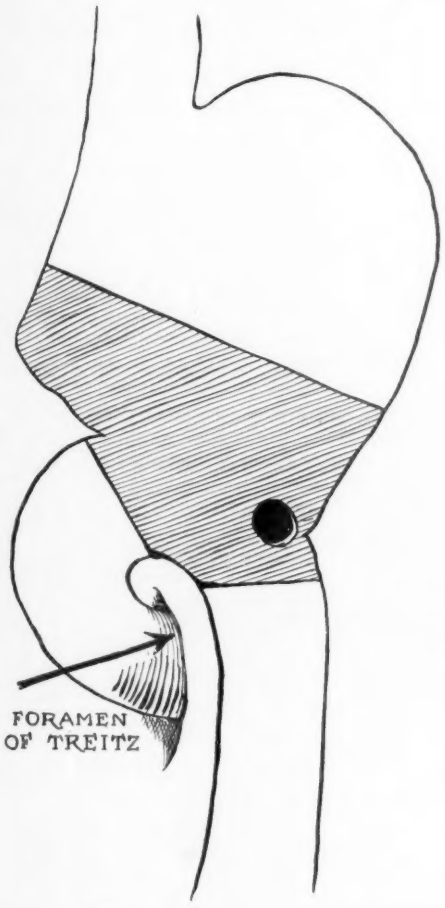


FIG. 1.—Diagram of resected portion of stomach and jejunum.

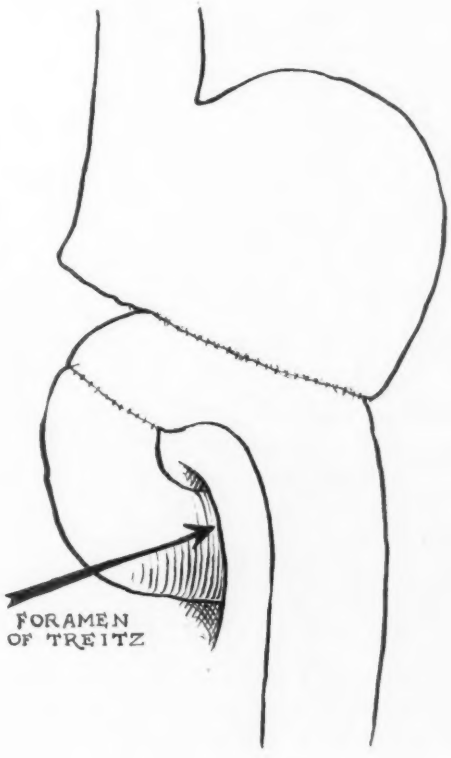


FIG. 2.—Secondary subtotal gastrectomy with jejunal anastomosis.

Doctor Lewisohn stated that this case presented a number of points of considerable interest:

(1) The size of the stomach at the second operation showed that an antrumectomy and not a partial gastrectomy had been performed through a right rectus incision at the primary operation. It is a well-known fact that pylorectomies and antrumectomies are followed by a large number of recur-

rent ulcers. Unless at least one-half of the stomach is removed, permanent cures cannot be expected.

(2) Negative X-ray findings do not exclude the presence of a gastrojejunal or jejunal ulcer.

(3) Failure to show free air under the diaphragm on the X-ray film does not exclude the presence of a free perforation.

(4) Extensive gastric resections may be performed with good results in the presence of an acute peritonitis, when the patient is operated on a few hours after the perforation. The impossibility of a safe closure of this large perforation made a gastric resection imperative. Furthermore, it was felt that simple closure of the perforation would have failed to cure the patient.

DR. FREDERIC W. BANCROFT said that he wished he could agree with Doctor Lewisohn regarding the primary cause of hyperacidity and in the certainty of the operative relief by a subtotal gastrectomy. Wright has suggested the fourth part of digestion as a reflux of bile and pancreatic juices through the pyloric valve. During this time the acidity is markedly decreased although the total chloride content remains the same. In cases of ulcer or in pylorospasm secondary to right lower quadrant diseases this reflux obviously cannot occur, and very possibly the hyperacidity noted is the result of the absence of this reflux and not *per se* due to an hypersecretion of the acid-forming cells. Should this theory be true, the cause of failure in operation may be due not so much to the lack of removal of acid-forming cells as it is to an operative procedure which does not allow ready reflux of duodenal juices and a fairly active emptying of the stomach.

Doctor Bancroft felt that some of the failures in pyloroplasty were due to the adhesions to the anterior abdominal wall and contraction of scar tissue, which did not allow proper relaxation, and resulted in insufficient reflux of the alkali. He also stated that experimental work had shown that if the distal loop be kinked or somewhat obstructed the percentage of jejunal ulcers markedly increased. There was also another factor to be considered in the cure of these cases: that is, the neurogenic or vitamine factor. This was illustrated by a patient who ran a small green goods grocery store. He had had a subtotal resection for ulcer and was doing well until, after the crash, he lost his business. He began worrying, smoking a good deal, not sleeping, and eating very irregularly. He was readmitted to the medical department with symptoms suggesting a jejunal ulcer, and radiological examination showed what appeared to be a definite jejunal ulcer. He was discharged very little if any improved. Not long after returning home, with an improvement in the financial aspect, he again gained control of his store. About a year has elapsed since he returned to his normal occupation. During that time he has gained ten pounds in weight, has no pain, works twelve to eighteen hours a day, does anything he wishes, and smokes moderately. He feels perfectly well. Certainly in this case it would seem that the change in his mental outlook had a great deal to do with his cure.

Dr. J. William Hinton said that Doctor Denneen reported a case of perforated gastrojejunal ulcer before the surgical section of the Academy in the early part of this year which was the second perforated gastrojejunal ulcer for this patient following a resection of his stomach in 1928. The first perforation occurred in May, 1930, and the second in January, 1933. During the past twenty-three years we have had, on the fourth division of Bellevue, 159 perforated ulcers but have only had two cases of perforated gastrojejunal ulcer and both of these occurred in 1933. It is interesting to note that the second perforated gastrojejunal ulcer occurred thirteen years following his original operation. In studying seventy-nine gastroenterostomies in the ulcer clinic of our division from 1928 to 1933 we encountered thirteen gastrojejunal ulcers or 16.4 per cent.

Doctor Lewisohn, in closing, said that he felt that acute perforations of the stomach or duodenum should rarely be subjected to a gastric resection, though the radical operation may have to be performed at a later date on account of persistence of symptoms.

THE FACTORS LEADING TO DEATH IN OPERATIONS UPON THE GALL-BLADDER AND BILE-DUCTS

Dr. George J. Heuer read a paper with the above title for which see Annals of Surgery, vol. 99, page 881.

Dr. Frederic W. Bancroft said that a number of years ago, on Doctor Pool's service at the New York Hospital, he had reviewed a series of acute cholecystitis. These cases were treated as surgical emergencies and the mortality was about 18 per cent. While he felt that acute cholecystitis should be treated relatively early and not allowed to remain in bed any considerable period of time before operation, he hoped the pendulum would not swing so far that they would again be treated as emergency cases. Patients with cholecystitis are usually over forty years, and apt to be obese. They are greatly improved with some pre-operative therapy. Moreover, the night equipment of operating rooms and the night anæsthesia are not as good as they are in the daytime, and Doctor Bancroft feels that in general these cases should be put on during a regular operative schedule where they could receive the best anæsthetic and operating-room care. He believed that if they were all treated as emergency cases there would be a rise rather than a fall in the mortality statistics.

Dr. Emil Goetsch recalled that some years ago he read a report of Dr. Elliott Cutler who analyzed a long series of complications following upper abdominal surgery particularly of the liver and gall-bladder, and that one of his conclusions was that pulmonary accidents were probably in large measure due to fat embolism. As was well known, many of these patients are adipose and in the manipulation of the fat of the abdominal wall and particularly the omentum and mesentery at operation, particles of liquid fat might be caused to lodge in the circulation. Thus multiple minute pulmonary infarcts might

readily result in pulmonary complications characterized by early pleural pain and expectoration of blood and subsequently by bronchopneumonia.

Dr. Thomas H. Russell read some figures from 200 cases operated on at Saint Francis Hospital that had some bearing, in his opinion, on the paper of the evening. They emphasized the importance of not waiting too long before operation. In 1930 he did seventy-three cholecystectomies for disease of the gall-bladder with six deaths. In 1931 he did thirty-two with no deaths; in 1932, thirty-nine with one death; in 1933, forty-six with two deaths. After 1930 he had felt he had made a mistake in waiting too long in some cases and within the last three years had operated within a day or so after the initial attack. In the series of 200 cases there were nine deaths. There was only one death in those with chronic cholecystitis. This case had many stones in the gall-bladder and there were a number of stones also in the common duct. The others were in cases with suppurative and gangrenous cholecystitis.

Dr. Henry W. Cave said that the pendulum seemed to be swinging toward early operation. The literature abounds with reports of cholecystectomies done soon after the patient has reached the hospital. Dr. Frank S. Mathews early took the stand of favoring early operation. At Roosevelt Hospital they had taken a medium ground, believing that the patients do better if they are kept over twenty-four or thirty-six hours and studied carefully as to blood chemistry and renal function, and estimation made how well they can stand operation. If the symptoms tend to subside they are not operated on for a week or ten days. If they do not subside, operation is done within forty-eight or sixty hours. Doctor Cave believed that what Doctor Bancroft had said was pertinent; if these cases are made acute abdominal emergencies there is a likelihood of increasing the mortality.

Dr. Condict W. Cutler, Jr., said that in considering acute cholecystitis it would be well if a distinction could be made between the cases which represented merely a mechanical hydrops of the gall-bladder and those in which severe infection was present with impending gangrene from impaired circulation in the cystic artery. Where this distinction was possible one could delay operation, allowing the jaundice to subside before doing a cholecystectomy which might then be attempted with less risk. In the infective cases, on the other hand, one should do an operation for relief as soon as the nature of the condition becomes apparent. If the patient's condition were bad and the infection severe it might be better in these cases to do a cholecystostomy if gangrene were not present to such degree as to make the removal of the gall-bladder obligatory. He wished to ask Doctor Heuer if he did not believe there to be a group of cases, of the acute infective type, in which the mortality might be lessened by the possibly temporizing but more conservative measure of cholecystostomy.

Dr. Ellsworth Eliot, Jr., said he had been impressed in Doctor Heuer's remarks by the fact that, as a rule, the actual cause of death after gall-bladder

operations, with or without autopsy, had been ascertained. There are, however, occasional instances of a fatal issue in which, after an uncomplicated, uneventful convalescence for a number of days, death has shortly or suddenly occurred without explainable reason. Doctor Eliot believed that in this group of cases two possible causes of death might be advanced: one, an obscure infection without evidence of any gross pathological change in either the liver or the adjacent peritoneum. Such an unusual infection, occurring infrequently in other organs of the body, may also occur here. A second possible cause concerns a disturbance of the delicate nervous mechanism in the upper part of the abdomen. Further study and investigation of these two possible causes may lead to some valuable results in reducing the mortality after these operations.

Doctor Heuer, in closing, said he was very grateful to the members of the New York Surgical Society for their discussion. With regard to Doctor Bancroft's remarks, he quite agreed with him. He had not intended to indicate he favored early operation in every acute case of cholecystitis that came to the hospital, but he did feel that the adoption of a waiting policy by surgeons was a mistake. One should be guided by the patient's condition and if there was an indication for early operation one should unhesitatingly proceed to perform it. In the speaker's past experience with a waiting policy a number of cases had perforated in the wards of the hospital. The very patients one did not want to operate upon, the elderly, were more prone to perforate than younger individuals.

Regarding Doctor Cutler's observations, Doctor Heuer said he could not visualize the pathology going on unseen in the body. If one could differentiate between two such groups of cases as described by Doctor Cutler one could wait in one group and operate immediately on another, but otherwise it would be hard to predict the outcome. Again referring to Doctor Bancroft's comment, he agreed that if everyone adopted a policy of operating on every case as an emergency, the mortality statistics would be raised. But, he maintained, early operation where indicated would lower the mortality. In regard to Doctor Goetsch's remarks, Doctor Heuer said he had no data regarding fat embolism as a complication in operations upon the gall-bladder.

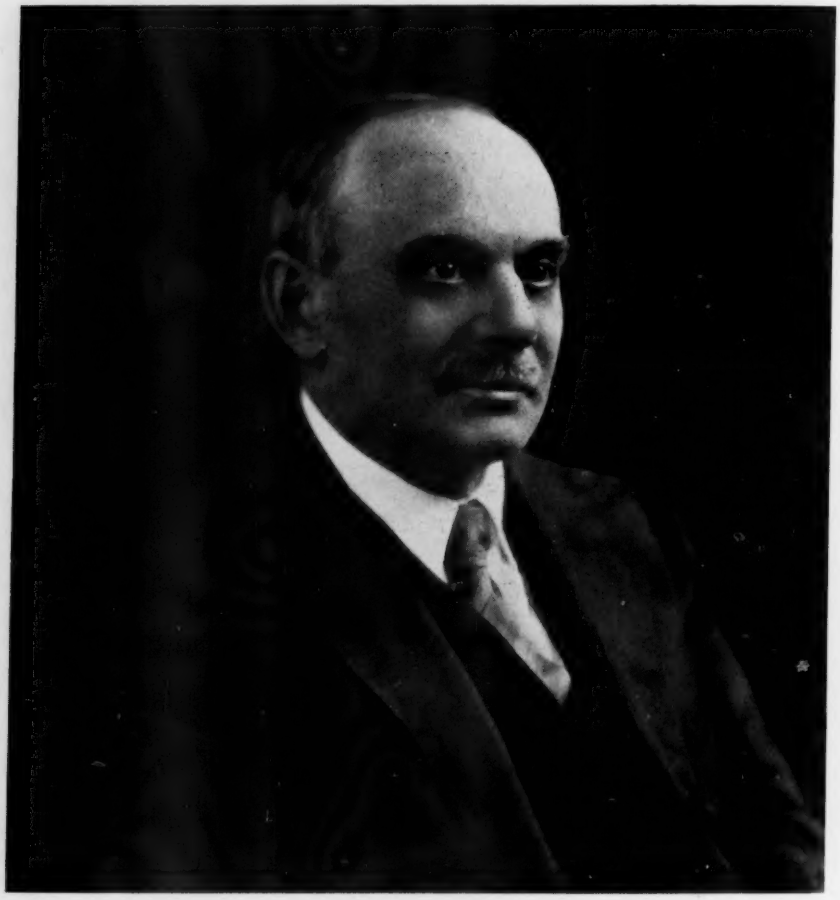
MEMOIR

MAX BALLIN

1869–1934

Dr. Max Ballin was born in Germany in 1869. He died in Detroit, Michigan, March 3, 1934.

Doctor Ballin's preparation for medicine was received in the Gymnasium



Max Ballin, M.D.

in Nordhausen, Prussia. His studies in medicine were pursued at Munich, Freiburg and Berlin and he received his medical degree at the University of Berlin in 1892 at the age of twenty-three. After the required period of military service and as a resident physician under VonBergman, Pettenkofer and Gerhart, he spent some time in the private clinic of Professor Karewsky.

On coming to America in 1896, Doctor Ballin settled at Leadville, Colorado, and in 1900 he came to Detroit. In 1906 he was appointed a consulting surgeon to Harper Hospital, became attending surgeon in 1908, and was appointed Chief of the Department of Surgery in 1917, a position which he held until 1933 when he was transferred at his personal insistence from the active to the consulting staff. During the war Doctor Ballin served with distinction in the Army Medical Corps. In 1917 he was elected to membership in the American Surgical Association, in addition to which he held membership in other representative national groups.

He was a careful observer and a list of his publications evidences the versatility of his interests. In recent years he had done outstanding work in the surgery of the thyroid and parathyroid.

The following resolution passed by the Staff of Harper Hospital indicates the respect and affection in which he was held.

"The Staff of Harper Hospital has lost, through the death of Dr. Max Ballin, a great and good man. For many years he has been the leading spirit of our institution.

"He stood before the community as the ideal physician—in skill, in industrious application to his calling, in understanding and helpfulness to the afflicted.

"He stood before us, his co-workers, in the field of medicine, as the embodiment of all that we would like to be.

"We were guided by his example and it is our hope that we may perpetuate his scientific and professional ideals."

FRED T. MURPHY

MEMOIR

BURTON JAMES LEE

1874–1933

DR. BURTON JAMES LEE died of coronary thrombosis, November 12, 1933. He was graduated from Yale and the College of Physicians and Surgeons and had an interneship at the Presbyterian Hospital.

BURTON JAMES LEE, M.D.

He soon obtained recognition as a competent and successful surgeon and his career was marked by a steady progress in this field, where he obtained well-merited recognition and distinction.

He was an associate surgeon of the New York Hospital for many years, but gave up this connection to concentrate on his work as attending surgeon

and clinical director at the Memorial Hospital, where he organized the Breast Clinic which has served as a model the world over.

He became chairman of the Committee on Malignancy of the College of Surgeons and president of the American Radium Society. He made many valuable contributions to the literature of cancer and diseases of the breast, including valuable articles in Keen's Surgery and the Oxford Loose Leaf Surgery.

He was active and prominent in the Great War, serving overseas from August, 1917, to January, 1919, first as a valued member of Base Hospital No. 9 (New York Hospital), finally becoming lieutenant colonel and consulting surgeon to the Second Division. He well deserved his Distinguished Service Medal and Croix de Guerre.

He was a successful teacher and greatly liked by students and his fellow members of the Cornell Medical Faculty.

He was consulting surgeon to the Sharon Hospital, Horton Memorial Hospital, Middletown, and the New York Infirmary for Women and Children.

He was a member of the College of Surgeons and one of its governors, of the Society for Cancer Control (secretary), the New York Surgical Society, American Society for Cancer Research, Harvey Society, Southern Surgical Society, Society of Clinical Surgery, Interurban Surgical Society, Radiological Society and the "Eclat" Club.

The tribute he particularly deserves cannot adequately be expressed in phrases. It must rest largely in the hearts and recollections of the many who esteemed and loved this man of sterling character and charming personality.

Doctor Lee was the altruist, always working helpfully and unselfishly for others, always kind, sympathetic and cheering.

He is survived by Mrs. Louise Freeman Lee, three children and three grandchildren.

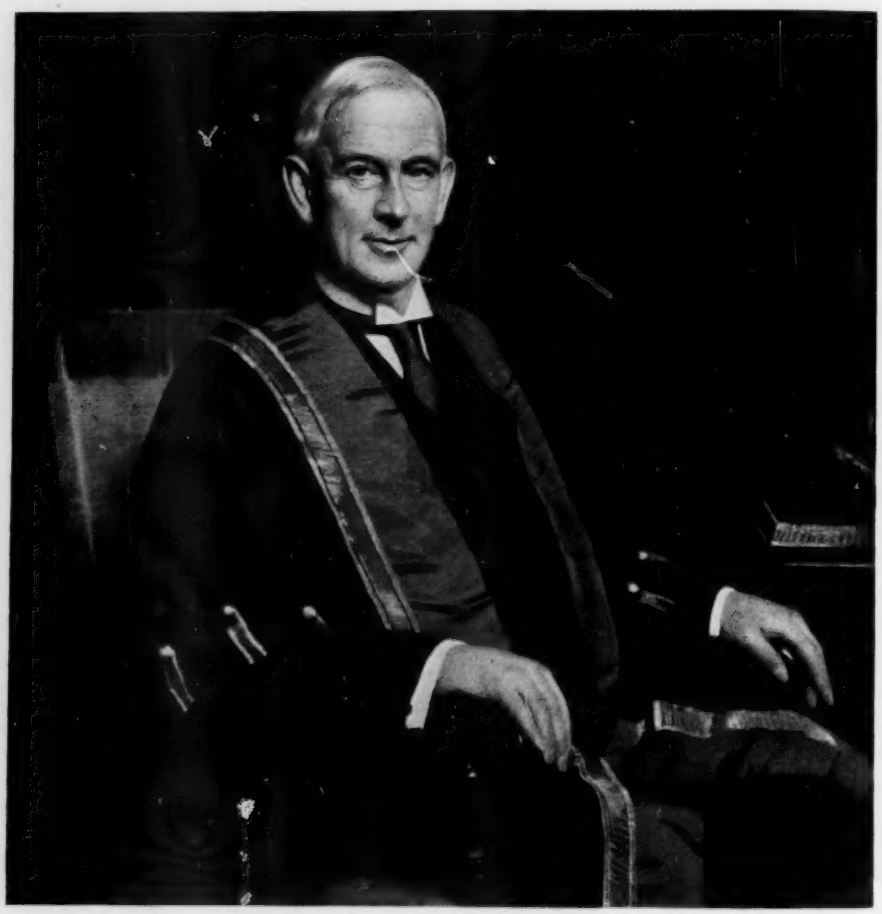
CHARLES L. GIBSON.

MEMOIR

FREDERIC NEWTON GISBORNE STARR

1867-1934

On April 21, 1934, there died in Toronto, Canada, Frederic Newton Gisborne Starr, M.D., Emeritus Professor of Surgery in the University of Toronto and a past Vice-President of this Society. Death came to him



Frederic Newton Gisborne Starr, C.B.E., M.B., M.D., C.M., F.R.G.S.
(After a painting by Joshua Smith, R.B.A.)

suddenly, in the midst of his everyday surgical work, and his career came to its close while he was still in full possession of his mental and physical vigor.

Doctor Starr was a teacher of the highest order. His long career was contemporaneous with the rise of the Medical School of the University of

Toronto and its success was contributed to strongly by his work in Anatomy and Surgery. As a teacher he excelled in the instruction of young surgeons and his quality is demonstrated by the standing of the men he trained. As a surgeon he was a master of his craft. No surgeon in Canada has achieved higher professional recognition and none was more beloved by his patients.

During the war he served with distinction with the Royal Army Medical Corps in France. For his services there he was mentioned in despatches and created a Commander of the Military Division of the British Empire.

Honors have been bestowed upon him freely. He has been President of the Ontario Medical Association, President of the Canadian Medical Association. Vice-president of the American Surgical Society. Vice-president of the American College of Surgeons, and President of the Royal College of Physicians and Surgeons of Canada. Of the latter college he was one of the founders and one of the chief forces which brought it into being.

The passing of Doctor Starr removes one of the outstanding surgical figures of Canada. He was known from one end of the country to the other and was admired and beloved wherever he went. The enormous funeral from Convocation Hall, with the crowds of colleagues, nurses and patients, bore witness to the way in which he is mourned.

W. E. GALLIE

MEMOIR

SIR WILLIAM TAYLOR

1871–1933

THE sudden death, January 30, 1933, of Sir William Taylor of Dublin, an honorary Fellow of the American College of Surgeons, came as a great shock to his many friends over the world.

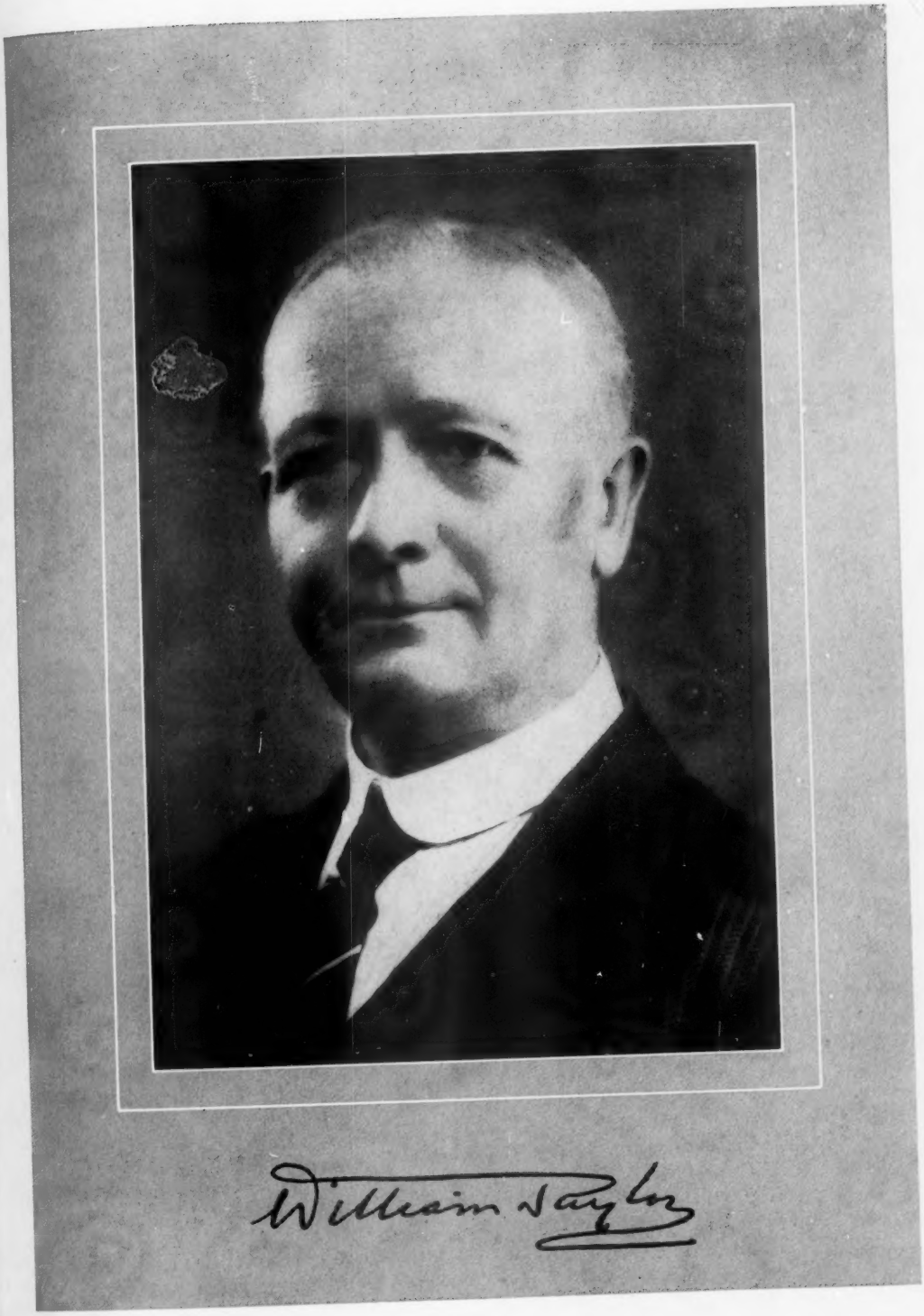
Sir William was born in County Donegal, September 21, 1871, and received his early education at The Strabane Academy. His later academic distinctions and his long service at the Meath Hospital have been recorded in the *Lancet*, as follows:

"Sir William Taylor, in the medical schools of the Irish Royal Colleges and the University of Dublin proved himself a distinguished student by securing the gold medal of operative surgery and the Mayne scholarship. From the University of Dublin he received the M.B. degree in 1901, having previously secured the F.R.C.S., Ireland. He was appointed assistant surgeon to the Meath Hospital in 1898 and as full surgeon in 1900. He was consulting surgeon to this hospital at the time of his death, so that he had given it life-long service."

Many honors were accorded Sir William in his own country, and last year, 1933, he was to serve as president of the surgical section of the British Medical Association which met in Dublin. He was elected to the Council of the Royal College of Surgeons in Ireland, and in 1914 was vice-president and president in 1916. On the outbreak of the war he was accorded the rank of colonel, Royal Army Medical Corps. He was one of the surgeons to the Dublin Castle Red Cross Hospital and at the request of the War Office he organized a hospital in France, selecting the staff from men too old for rigorous service. During the war he was indefatigable, and his energy and skill while working with the "83 (Dublin) General Hospital" at Boulogne was recognized with the C.B. in 1917 and the K.B.E. in 1918.

In 1922, Sir William became Regius Professor of Surgery at Dublin University, and in 1923 surgeon to Sir Patrick Dun's Hospital. He was president of the Association of Surgeons of Great Britain and Ireland in 1924–1925 and was president of the Royal Academy of Medicine in Ireland in 1927. In addition to his posts at the Meath Hospital and at Sir Patrick Dun's Hospital, he was consulting surgeon to the Coombe Lying-in Hospital, the Stevens Hospital, and the Dental Hospital of Ireland. As was said in the *British Medical Journal*, "Few men can have combined so many important posts or acquitted themselves in their multifarious obligations with greater ability."

The papers which he presented before various meetings in North America,



and his contributions to medical and surgical literature were obviously based on large experience, and this, with his sound common sense, gave great weight to his opinions in many fields of clinical surgery. Those who have been privileged, as I have been, to visit his surgical wards at Sir Patrick Dun's Hospital, and other hospitals of Dublin, will recall the wide range of his surgical knowledge, his technical skill, his directness, and his forceful teaching. These qualities in a man of his engaging personality made such visits never to be forgotten.

William J. Mayo, in speaking of a visit to Dublin in 1923, wrote of Sir William as "a gifted teacher and surgeon." Dr. Mayo continued, "I have heard him give a graphic description of infantile intussusception, stressing the sudden crying out of the child, the pallor, the vomiting and the explosive movements from the bowels. In none of his cases has he had recurrence after operative reduction. In performing splenectomy in cases of anæmia he immediately transfuses the free blood in the spleen to the patient. He has had noteworthy success in handling cases of acute obstruction of the bowel, using an high enterostomy, with two tubes, for the purpose of emptying the toxic contents of the bowel, and of nourishing the patient."

Honors came to Sir William not only at home, but abroad and it was on the occasion of his first visit to this continent that he was made an Honorary Fellow of the American College of Surgeons at the meeting in Montreal in 1920 and he gave the Fellowship Address that year. It was at this time that Sir William, Sir Berkeley Moynihan, and Mr. A. Carless, representing the Consulting Surgeons of the British Armies in the World War, presented the Great Mace to the American College of Surgeons.

Sir William was elected an Honorary Member of the American Surgical Association in 1924, and in 1927 the degree of LL.D. was conferred on him by McGill University. He had a real admiration for American and Canadian medical schools and teaching and the affection in which he was held by the surgeons of these countries was fully reciprocated. His great personal charm, vivacity, wit, friendliness, and exuberant good health made him always welcomed as a visitor in America by his many friends in and out of the medical profession. Those who had the privilege of knowing Sir William Taylor can understand the tribute of a colleague who wrote of him: "Honest in his work, honest in his dealings with all men, and fearlessly faithful to his convictions, his passing is a tragic loss to his profession and to his country."

DONALD C. BALFOUR, M.D.

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